THE INFLUENCE OF THE TONGUE ON VOCAL PRODUCTION

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The purpose of this study is to assemble information needed to assess, understand and hopefully correct muscular hyperfunction that is related to tongue tension in singing and speech which inhibit freely, efficiently, and comfortably produced beautiful singing. This text will include a definition of freely produced, fully resonating tone for beautiful singing, major components of vocal technique, physiology related to singing and speech production, hyperfunctions associated with tongue tension, tongue involvement in the articulation of the four major singing languages, and will present exercises for training the muscles of coordination in a manner conducive to singing and speech.

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CHAPTER 1

INTRODUCTION

Beautiful singing in the western tradition usually take years of training to acquire, training which hopefully can yield all necessary skills needed for this type of singing. Even with excellent skills there can still be singing issues that can hold back a trained or aspiring singer from advancing. One of these issues is tongue tension. Kate Emile-Behnke, in her book Singers' Difficulties: How to Overcome Them[1] describe problems of the unruly tongue for singing thusly:

> It [the tongue] slips back into the throat, the root tightens, it rears up when it ought to lie down, it flattens itself when it ought to curve, intercepting and breaking up the sound waves, plugging the throat, fixing the larynx, and blocking the sounding chamber of the mouth; its failure to adjust and readjust prevents purity of vowels, and its lack of agility makes crisp consonants impossible.

Vennard, Miller, Brown and Browning Henderson[2] all note that excessive tongue tension can be an impediment for beautiful free singing.

In order to master freely, efficiently produced, beautiful singing, a singer with tongue tension will need to learn new muscular coordinations, abandoning old muscular habits, and establishing new routines. This can necessitate adjustments, training and retraining, not only of singing coordination, but also of speech execution. How the tongue is used can cause vocal hyperfunction, and less-then-optimal acoustic results. Vocal hyperfunction is the abuse and misuse of the voice and can occur in both singing and speaking.

It would be highly significant if there could be collected into one source, all the information needed to address the possible singing and speaking coordination that lead to

[1] K. Emile-Behnke. *Singers' Difficulties: How to Overcome Them.* New York: Frederick A. Stokes Company, (n.d), 108.

[2] W.Vennard, Singing, *the Mechanism and the Technique*. New York: Carl Fischer. (1967); R.Miller,*The Structure of Singing.* New York: Shirmer Books, (1996); O. Brown, *Discover your Voice: How to Develop Healthy Voice Habits.* San Diego, CA: Singular Publishing Group (1996); L. Browning Henderson, *How to Train Singers.* West Nyack, N.Y. Parker Publishing Company Inc. (1979)

hyperfunction. The purpose of this study is to assemble information needed to assess, understand and hopefully correct muscular hyperfunction that is related to tongue tension in singing and speech which inhibit freely, efficiently, and comfortably produced beautiful singing. This will include a definition of freely produced, fully resonating tone for beautiful singing, major components of vocal technique, physiology related to singing and speech production, hyperfunctions associated with tongue tension, tongue involvement in the articulation of the four major singing languages, and will present exercises for training the muscles of coordination in a manner conducive to singing and speech.

CHAPTER 2

SINGING

Definition of Freely Produced, Fully Resonating Tone for Beautiful Singing

According to acoustical research done by Clayne W. Robison[3], there are six complex signals that need to be present for beautiful singing.

1. A smooth signal specifically including a continuos even vibrato.
2. A balanced signal; meaning a balance of bright and dark frequencies (chiaroscuro) in the tone.
3. A clean signal that is in tune with the natural harmonic overtones simultaneously created above the sung fundamental pitch.
4. A projected signal containing a high percentage of overtone frequencies, known as the singer's formant that lies between 2800-3500 Hz.
5. A consistent signal that remains constant as it moves between pitches, between vowels and from soft to loud and loud to soft.
6. A comprehensive signal that allows the consonants to come through naturally and understandably.

Recent research done by Ingo Titze and colleagues at the University of Iowa and the Voice Center in Denveras reported by Robison[4] shed new light on how the body creates beautiful singing. All vibrating parts, including the air to produce singing that is used by the body, must be simultaneously and completely inter-responsive to one another. This interactivity is critical at vocal onset. All the major oscillating factors are needed at the start of the sound for ultimate beauty of singing but once started, legato line also becomes critical. Robison writes, "Once all of the major oscillating factors critical to vocal beauty have been interactively engaged at onset, they should continue to be interactively carried from note to note right through the pitch

[3] C. Robison. "Beautiful Singing: What It Is and How to Do It." *Journal of Singing* 58:1 (2001), 24.
[4] Ibid., 10.

changes, as well as through the speech-like articulations. To allow them even slight disengagement during the movement from note to note or vowel to vowel, or even during the consonant articulations, will require total realignment of the interactive network . . ."[5]

If the articulatory activity and the breath creating activity can interact freely at the instant of onset, Robison suggests that the vocal folds and the interactive resonance chambers can be drawn into this interactive network, for the succeeding vowel. The conclusion drawn is that a continuos interactivity of the major resonance chambers[6] both above and below the vibrating vocal fold is of utmost importance for freely produced, fully resonating tone for beautiful singing. In addition there must be freedom in articulation with a soft, flexible tongue without unnecessary tension for production of continuos vowel and consonant flow.

Major Components of Vocal Technique

Breath

Breathing for life and breathing for communication use an inhalation process and an exhalation process. On inhalation, the diaphragm contracts downward into the abdominal area, pulling the lungs down for expansion to allow air intake. The ribcage also expands, supported by the external intercostals. Inhalation can be quiet, or noisy and forced. On exhalation the diaphragm returns upward to its resting position and, the lungs and ribcage recoil. Exhalation can be passive or forced. In the forced active exhalation, more muscular effort is used, especially for the second half of the breath phase. Air volume and air pressure vary as a direct function of the forces acting on the respiratory system.[7] While singing or speaking we modify the respiratory activities to fit the needs of movement, and of communication. When needed, the

[5] Ibid., 11.

[6] Nasopharynx, oral pharynx and hypopharynx.

[7] J.A Seikel, D. W. King and D.G. Drumright. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 145.

body generates greater air pressure by contracting the muscles of expiration, the internal intercostals, external obliques, and the rectus abdominus when the lung volume is less then resting lung volume, although both the diaphragm and external intercostal (muscles of inhalation) also show small amounts of activity during expiration. For singing the controlled inspiration and expiration used for extended phonatory production is called *breath support*.

Miller[8] did a study of four schools of singing. Three of the four schools, English, German and Italian, use the abdominal wall muscles. The French school consider breathing for singing no different from breathing for life.

The English school uses a method called "fixed diaphragm." The abdomen is pulled up and in on inhalation, while the ribcage is expanded. The organs in the abdomen will be pressed into a position against the diaphragm to stabilize it. It has been observed that this technique often produces neck and tongue tension and a tone with inconsistent, or no vibration (vibrato).

The German school encourages an erect head/neck alignment, a high chest and an inward tilted pelvis where the buttocks are pulled in. This will cause a slight tension in the lower abdominal region. Though Miller found this technique to cause tension in the lower abdominal area, this technique does not seem to contribute to the adverse conditions of excessive neck and tongue tension.

The Italian school also uses the abdominal muscles for breath support. To control the voice, the Italian method advises the singer to use the diaphragmatic contraction downward against the viscera to create appropriate compression of breath. The abdominal muscles are kept in slight contraction while inhaling.[9] The Italian method of breath support is called *appoggio*.

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[8]R. Miller, *English, French, German and Italian Techniques of Singing: A Study in National Tonal Preference and How They Relate to Functional Efficiency*. New Jersey: The Scarecrow Press Inc, (1978)

[9] A. Cobb-Jordan, *The Study of English, French, German and Italian Techniques of Singing Related to Female Adolescent Voice*. Master Thesis, University of North Texas, (2001)

Miller[10] states that "*appoggio* is a system for combining and balancing muscles and organs of the trunk and neck, controlling their relationship to the supra glottal resonator so that no exaggerated function of any one of them upsets the whole . . ." The *appoggio* technique maintains the posture close to the one at inspiration so that cooperative muscular activity can occur in the torso, pectoral, epigastric, umbilical, abdominal and diaphragmatic regions. "Sing in the position of breathing - breathe in the position of singing."[11]

As stated by Robison[12], research done by J. Sundberg show that singers with the most beauty in their voices seem to use the lower oblique muscles and the sphincters in flexible antagonism with the central part of the diaphragm. With this muscular interactivity the singers seemed to have a more effortless "flow phonation,"[13] strong clean overtones, an even and constant vibrato, a flexible legato line, and clear and energized articulations.

Vocal Fold Involvement and Vibration

When exhaling, the air passing through the vocal folds can draw them together causing them to vibrate and produce a tone, an oscillation similar to a double reed. A clean and rich acoustical signal is made by "wide-surfaced, flexible vocal folds bursting rapidly apart and the flapping rapidly and clearly together."[14] The "less then optimal results" referred to in the introduction can be partially due to "narrower-surfaces"and, less flexible vocal folds parting more sluggishly, then clapping less clearly together.[15] The aerodynamic process known to physicists as the Bernoulli effect states that "given a constant volume flow of air or fluid, at a

[10] R.Miller. *The Structure of Singing* New York: Schirmer Books , (1996), 23-24.
[11] Ibid., 25.
[12] C. Robison. "Beautiful Singing: What It Is and How to Do It." *Journal of Singing* 58:1(2001), 14.
[13] Ibid., 14.
[14] Ibid., 13.
[15] Ibid., 13.

point of constriction there will be a decrease in pressure perpendicular to the flow and an increase in velocity of the flow."[16]

Sundberg has shown that a combination of Bernoulli effect with floppy vocal folds and resonance, called flow phonation, is substantially more efficient than tauter vocal folds, or than too much breath released past the vocal folds (breathy phonation). Flow phonation is "lower subglottal pressure and lower adductive force."[17] In addition to vocal fold functions of vibration and sound, they also play a very small part in vowel production.

The source-filter theory of vowel production credits the vocal folds as contributors to vowel sound. Seikel[18] et al. refer to it as: "In general terms, the theory states that a voicing source is generated by the vocal folds and routed through the vocal tract where it is shaped into the sounds of speech. Changes in the shape and configuration of the tongue, mandible, soft palate, and other resonances of the tract determine the sound of a given vowel."[19] The vocal folds will oscillate when there is sufficient airflow and they can approximate themselves. When the edges of the vocal folds come in rapid contact with each other due to the oscillation and approximation of the vocal folds, a buzzing sound is produced, which is the voicing source.

Resonance

Resonance is the acoustic phenomenon of amplification of a sound wave that occurs in an air-filled chamber where the chamber walls vibrate similarly[20]. The primary resonators for human vocal phonation are the hypopharynx, the nasopharynx, the oropharynx and the mouth.

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[16] J.A Seikel, D. W. King and D.G. Drumright. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 164.

[17] J. Sundberg. *The Science of the Singing Voice.* DeKalb: Northern Illinois University Press (1987), 80.

[18] J.A Seikel, D. W. King and D.G. Drumright. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 266.

[19] Seikel et al. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 266.

[20] R.J.Prater, R. Swift. *Manual of Voice Therapy.* Boston: Little,Brown & Co. (1984)

They are called the vocal tract resonator tube. Based on Titze's research Robison articulates the newest theory and understanding of interactive singing whereby it is "probable that interactions between the vocal folds and the tracheal resonance below them might be as relevant to the free vibration of the vocal folds as has been found to be the case with the interactions between vocal folds and the pharyngeal resonances above them."[21] Reid writes about the same resonance phenomenon as being ". . . a tonal reinforcement in the region of the trachea and bronchi, certainly within the laryngeal pharynx . . . [one being] aware of an effective speaker having a rumbling sound in the region of the chest."[22]

According to Browning Henderson "the nasal cavities are also involved in resonance of tones, either as a focal point for sympathetic vibrations or as an area for resonance per se." They are also important to the quality of the voice either balanced or nasal.[23] Austin disagrees, writing "the fullness, the intensity, the ring in the voice comes when the nasal cavity is separated from the vocal tract by lifting the soft palate."[24] He suggests that the vibration many singers feel in the front of the face may be due to strong secondary vibrations, not nasalization.[25] Vennard also discussed the nasal cavities involvement in resonance of tone, suggesting them to be secondary vibrations.

Seikel et al.[26] explain the initial vibration as vocal fold production of a quasi-periodic tone that is passed through the filter of the vocal tract. Manipulation of the vocal tract shape will lead to changes in the sound. Acoustically this quasi-periodic tone is a complex tone, consisting

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[21] C. Robison. "Beautiful Singing: What It Is and How to Do It." *Journal of Singing* 58:1(2001), 12.

[22] C.Reid. *The Free Voice.* New York:The Joseph Patelson Music House,(1974), 215.

[23] L.Browning Henderson. *How to Train Singers.* West Nyack, N.Y. Parker Publishing Company Inc. (1979), 45.

[24] S.F.Austin. "Nasal Resonance - Fact or Fiction." *Journal of Singing* 57:2 (2000), 40.

[25] Ibid., 39.

[26] J.A Seikel, D. W. King and D.G. Drumright. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 266-267.

of energy at the fundamental frequency (F0) and at predictable frequencies above the F0. The fundamental frequency is determined by the number of times in a second that the vocal folds open and close. The resonance is the result of a series of overtones or partials occurring at frequencies that are integer multiples of F0. (For example: If F0 is 220 Hz, F1 will be 440, F2 will be 660 a.s.o.) All these pitches occur simultaneously and make up the sound emitted from the larynx. The fundamental (first partial) is the strongest with each successively higher partial (overtone) being less intense. The resonance frequencies (formants) are determined by the shape of the vocal tract. The individual configuration and shape of each person's pharynx and larynx is predetermined and the upper portion of the vocal tract is defined by the position of the tongue and the lips. The length of the vocal tract is also determined by the position of the larynx in the neck. A low laryngeal position results in a longer vocal tract. Varying the shape of the vocal tract and producing different vowels do not change the frequency of the fundamental or the frequency of the partials, but because the relative intensity of the partials is being altered by the formants of the vocal tract, we hear different qualities of timbre associated with different vowel sounds[27]. The activities of the genioglossus, geniohyoid and strap muscles of the larynx are associated with the rise of the larynx. They pull the hyoid bone and thyroid cartilage forward and upward, causing a tilt of the thyroid cartilage that may stretch the length of the vocal folds and lead to increase of fundamental frequency[28].

Singer's Formant

Early studies by Paget, Delattre, and Bartholomew, and later by Vennard identify an acoustical phenomenon now commonly called the singer's formant. Austin describes the singer's

[27] E.F. Timerding. "Taming of the Unruly Tongue: Problems and Remedies Associated with the Singer's Tongue." *Journal of Singing* 54:2(1997), 35-36.

[28] K. Honda. "Relationship between Pitch Control and Vowel Articulation."In D.M. Bless, J.H. Abbs eds. *Vocal Fold Physiology: Contemporary Research and Clinical Issues*. San Diego, California:College-Hill Press

formant as " a unique clustering of acoustic energy that provides the voice much of its carrying power. It is the "ring" in the voice . . . and usually occurs around 2800 Hz."[29] This special energy is mostly shown in the area between 2500-3200 Hz, and regardless of vowel, is usually present in resonant singing.[30] Scientific experiments have shown an association between tongue involvement and fundamental frequencies, which supports the importance of the free and efficient tongue in producing beautiful singing and optimal resonance.

Fundamental Frequencies and Tongue Involvement

According to research done by Lin et al., tongue protrusion is associated with decreased fundamental frequency with head extension[31]. These findings support a physical-linkage hypothesis of the relationship between vocal tract configuration and vocal fold vibration, suggesting that vocal tract configuration can affect the optimal vibratory frequency and the stability of vocal fold vibration. This suggests that head-tongue position must be taken into account when comparing vocal fundamental frequency and perturbation measures.

In a study of normal voice, Orlikoff found that when fundamental frequency was held at a constant level, jitter and shimmer values did not vary significantly by vowel.

A high vowel made with the the highest point of the tongue positioned close to the palate, for example [i], tends to exhibit a higher fundamental frequency than a low vowel that was produced with the highest point of the tongue far away from the soft palate for ex. [a][32]. Lin et. al argue that variations of perturbation measures among vowels are due to the difference of the intrinsic pitch among vowels.

(1981), 286-297.

[29] S.F.Austin. "Nasal Resonance - Fact or Fiction." *Journal of Singing* 57:2 (2000), 38.

[30] J.Sundberg. *Research Aspects on Singing* (Stockholm: The Royal Swedish Academy of Music. 1981)

[31] Lin et al. "Effects of Head Extension and Tongue Protrusion on Voice Perturbation Measure." *Journal of Voice*14:1 (2000), 8-16.

[32] R.F Orlikoff. "Vocal Stability and Vocal Tract Configuration:an Acoustic and Electroglottographic

According to Ewan, the concept of "intrinsic vowel pitch" arises from observations that fundamental frequency varies with tongue height, defined as the highest point on the tongue relative to the roof of the mouth during vowel production[33]. Ewan's study also found that the fundamental frequency of nasal consonants embedded in vowels, was affected more by the formant structures of the adjacent vowels, than by its own formant structure, demonstrating a coarticulatory anticipation of the tongue and jaw, thereby supporting a physical linkage hypothesis.

In a comparative study of the effects of mandible positioning, tongue pull, and tongue compression on fundamental frequency, Zawadski and Gilbert found the mandible position to have the greatest effect on fundamental frequency, followed by the tongue pull and tongue compression.[34]

In a study by Shrivastav et al., no significant differences in the first and second formant frequencies were found when research subjects did the various tasks asked of them. This indicated no differences in tongue position in the four vocal stimulation techniques used: the yawn-sigh, gentle onset, forward focus, and voiceless fricative[35].

Boone and McFarlane reported tongue retraction following the yawn-sigh approach[36]. But the results from the Shrivastav et al.'s study indicates no changes in the tongue position for the first 100 ms (millisecond) of phonation which suggests that changes in the laryngeal parameters (F0, jitter and SNR) were not due to tongue or jaw movements, but primarily caused

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Investigation." *Journal of Voice* 9(1995), 173-181.

[33] W.G Ewan. "Can Intrinsic Vowel F0 be Explained by Source/Tract Coupling?" *Journal Acoust Soc Am* 66(1979), 358-362.

[34] P.A Zawadski and H.R Gilbert. "Vowel Fundamental Frequency and Articulatory Position." *Journal of Phonetics* 17(1989), 159-166.

[35] R. Shrivastav, H. Yamaguchi. and M. Andrews. "Effects of Stimulation Techniques on Vocal Responses: Implications for Assessment and Treatment." *Journal of Voice* 14:3(2000), 322-330.

[36] D.R. Boone , S.C McFarlane. *The Voice and Voice Therapy*. 5th Ed. Englewood Cliffs, NJ: Prentice Hall

by the changes directly affecting the laryngeal mechanism. In a different study Honda[37] says that the tongue and jaw position can affect the F0 due to the muscular connection between the two positions.

Body Posture

Variances in body posture affect alignment of mouth and throat cavities, the releasing of the jaw, and efficiency in respiration. Therefore it can affect tongue position and state of tension in the tongue. Robison [38] suggests singers with beautiful voices use a flexible combination of the following.

1. Noble chest elevation throughout both inhalation and phonation.
2. Shoulders rolled moderately back and down.
3. Neck free, long and back . . . a flexible “arching-back" of the neck.
4. Skull lifting up and away from the spine with the head tipping forward and down.
5. Hips brought forward in alignment with the upper torso while buttocks are rolled slightly back and down.

The same body posture has been observed at workshops led by Alexander Technique teacher Phyllis Richmond of Dallas, and by former principle flutist Harvey Boatwright of Dallas Symphony Orchestra. Singers participating in the workshops used these posture suggestions and great improvements were present immediately in all singers. According to Barlow[39] Alexander said, "freedom of alignment allows the body to use its energy far more economically and is especially efficient because no undue tension is present.” Browning Henderson suggest that a flexed knee position is one of the most important factors in correct body alignment because it

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(1994).

[37] K. Honda. "Relationship Between Pitch Control and Vowel Articulation.” In D.M. Bless, J.H. Abbs eds. *Vocal Fold Physiology: Contemporary Research and Clinical Issues.* San Diego, California:College-Hill Press (1981), 286-297.

[38] C. Robison. "Beautiful Singing: What It Is and How to Do It." *Journal of Singing* 58:1(2001), 17.

[39] W. Barlow. *The Alexander Technique.* New York:Alfred A. Knopf (1973)

gives freedom in singing from low range to high range. She also states that "[for] a singer [who] involve the legs, the tone becomes freer and fuller and the range of the voice widens." If the head is held too high or too low the tongue muscles tighten and pull or are pressed. This will result in abnormal and changed sound production.[40] Seikel et al.[41] states that "Body posture is a significant contributor to efficiency of respiration, and any condition that compromises posture also compromises respiration .

Head Positioning

The pharyngeal-oral resonating structures will change with different head positions and a change of vocal quality (either better or worse) may occur. Persons with vocal hyperfunction often experience a better, more relaxed voice by placing the head in a different position.

According to Boone and McFarlane[42], patients with vocal hyperfunction often benefit from neck flexion with the chin tucked down toward the chest. This position seems to promote greater vocal tract relaxation, and together with other therapy techniques, work for greater oral openness and ease of vocal production. The best vocal exercises to use when locating optimal head/neck alignment are prolongation of vowel such as /i/, /ɪ/, /ɛ/, /æ/, /o/, /ʌ/,/u/.

Not only when standing and singing for concert or chorus work, but when moving on stage for opera or musical theater, is it important to retain the head/neck alignment.
The head should be in a level position, with the nose pointing in a direction parallel to the ground[43]. One problem related to inapt head position is that the tongue muscles are either

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[40] L. Browning Henderson. *How to Train Singers*. West Nyack, N.Y. Parker Publishing Company Inc. (1979), 63.

[41] J.A Seikel, D. W. King and D.G. Drumright. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 148.

[42] D.R. Boone , S.C McFarlane. *The Voice and Voice Therapy.* 5th Ed. Englewood Cliffs, NJ: Prentice Hall (1994), 195

[43] L. Browning Henderson. *How to Train Singers*. West Nyack, N.Y. Parker Publishing Company Inc. (1979), 62.

pressed, pulled or tightened therefore altering the sound output which compromises beautiful singing. The problem with inapt head position was recognized by Alexander and is one of the pillars in his work. His teachings are now the popular and effective training for head/neck alignment. Browning Henderson states that "the head should not be moved solely from the neck."[44] If a singer in a staged production is required to sing with the head held in a position less beneficial for optimal vocal production, she suggests the singer move the torso slightly to follow the head movement.

Summation

Most published vocal pedagogues, including Vennard, Miller, Reid, Browning Henderson, Coffin and others, will agree that great singing demands complete breath control. They will also agree to the importance of the vocal folds having a balanced onset; neither glottal nor aspirate. This makes vocal fold onset one of the primary objects of importance for beautiful singing.[45]

However, common practice finds that a singer can have optimal breath support and the desired vocal fold onset as described earlier, but still be hampered by excessive tongue tension. Therefore such a singer must examine the specific areas of vocal production, singing and speech, that involve the tongue, in order to delve further into areas of articulation, languages and their differences, and the use of the tongue. Such a singer will need to address these areas of tongue tension for free, beautiful singing.

[44] Ibid., 62.
[45] C. Robison. "Beautiful Singing: What It Is and How to Do It." *Journal of Singing* 58:1(2001)

CHAPTER 3

PHYSIOLOGY[46]

One of the most powerful, automatic and often used body reflexes is that of swallowing. When swallowing, the tongue tenses and moves backward in the oral cavity, the larynx rises into a jamming position up under the tongue and epiglottis, the epiglottis drops to cover the trachea and the vocal folds are adducted. If this reflex of swallowing interferes with singing, the tension in the tongue root will hamper vowel and consonant production and phonatory resonance in the oral cavity. Hargrave[47] writes ". . . that the functions of swallowing and singing operate alternately, otherwise there would be a constant state of confusion exemplified by both mechanisms pulling against each other."

The larynx/hyoidbone/tongue complex act as an anatomical unit. During swallowing the vocal folds stop the airflow to or from the lungs by closing off the hypopharynx. In infants, the larynx can rise to the first or second vertebrae, and the epiglottis can rise into the nasopahrynx over the soft palate, during swallowing. This causes a complete separation of food and air passages so that they can swallow and breathe at the same time. This high position of the larynx and the tongue makes the modification of some sounds impossible because there is no supralaryngeal portion of the pharynx available; therefore, only a restricted range of vocalization is available to the infant. When the laryngeal apparatus descends at around age two, speech develops and the child can begin to produce vowels [i],[u] and [a][48] .

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[46] Unless noted otherwise this chapter is from *Anatomy and Physiology for Speech, Language, and Hearing* 2nd edition by SEIKEL. Copyright 2000. Reprinted with permission of Delmar Learning, a division of Thomson Learning: www.thomsonrights.com.

[47] W. Hargrave. *The Genio-Hyoid Vocal Interference*. Master's Thesis, North Texas State College,(1960), 25.

[48] J. Westerman Gregg. "Voice Teaching and Laryngeal Maturation." *Journal of Singing* 56:3(2000), 67-69.

Tongue

The tongue is a massive structure occupying the floor of the mouth. Anatomically and functionally the tongue can be divided into intrinsic and extrinsic musculature. The extrinsic muscles are primarily responsible for moving the tongue into the general region desired, while the intrinsic muscles primarily provide the fine graded control of the articulatory gestures for speech. In addition to its function for speech and singing articulation, the tongue is responsible for the movement of food within the oral cavity to position it for chewing, and to move it backward for swallowing.

The tongue is divided longitudinally by the median fibrous septum, a dividing wall between right and left halves that serve as the point of origin for the transverse muscle of the tongue. The median fibrous septum originates on the body of the hyoid bone via the hyoglossal membrane, forming the tongue attachment with the hyoid. It is the same length as the tongue.

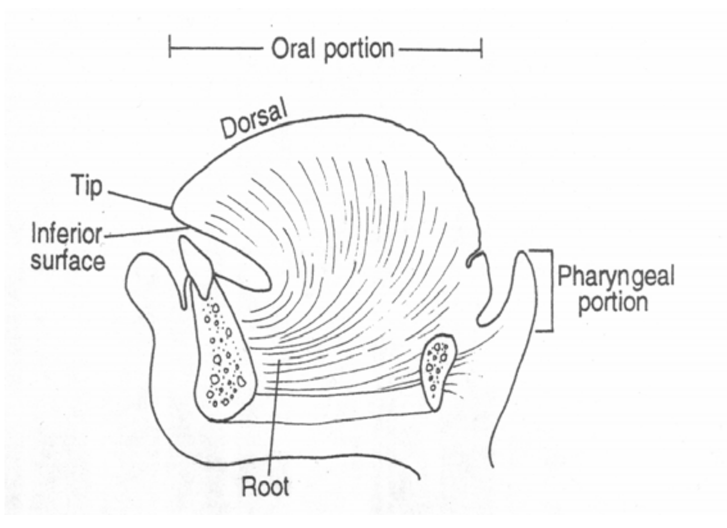

Figure 3.1 Regions of the tongue (cross section).

The tongue can be divided into sections to identify its characteristics. Its superior surface is referred to as the dorsum, and the anterior-most portion is the tip or apex. The base of the tongue is the portion of the tongue that resides in the oropharynx. The portion of the tongue surface within the oral cavity is referred to as the oral or palatine surface, making up about two-thirds of the surface of the tongue. The other third of the tongue surface lies within the oropharynx and is referred to as the pharyngeal surface.

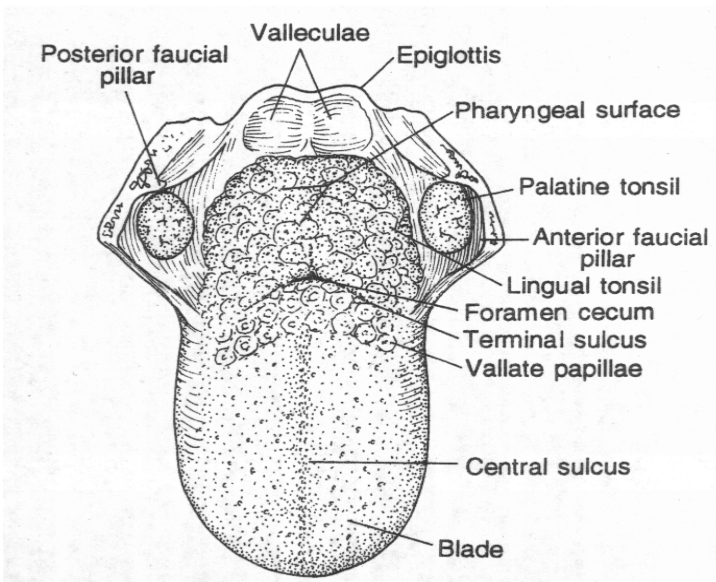

Figure 3.2 Landmarks of the tongue.

The mucous membrane covering the tongue dorsum has numerous landmarks. The prominent median sulcus divides the tongue into left and right sides. The posterior of the tongue is invested with lingual papillae, small irregular prominences on the surface of the tongue. The terminal sulcus marks the posterior palatine surface, and the center of this groove is the foramen cecum, a deep recess in the tongue.

Beneath the membranous lining of the pharyngeal surface of the tongue are lingua, tonsils, and groups of lymphoid tissue. In combination with the pharyngeal and palatine tonsils, the lingual tonsils form the final portion of the ring of lymph tissue in the oral and pharyngeal cavities. Tonsils tend to atrophy over time. Although the pharyngeal and palatine tonsils may be quite prominent during childhood, they are markedly diminished in size by puberty.

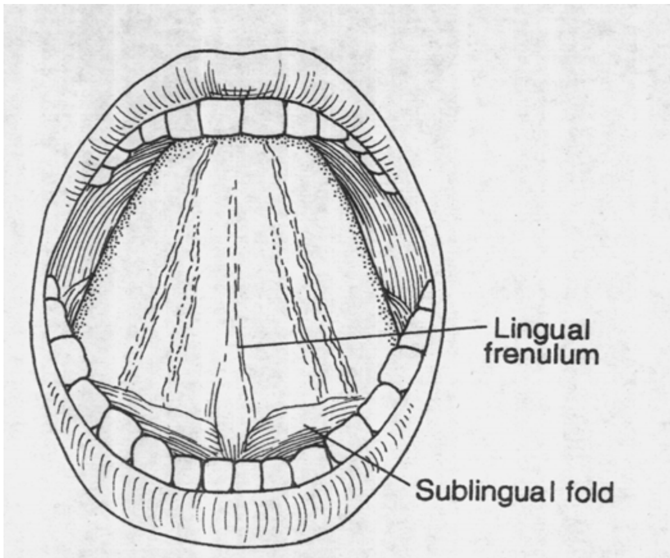

Figure 3.3 Interior surface of the tongue.

The tongue has taste buds which relate the sense of taste. The tip of the tongue has receptors sensitive to both sweet and sour tastes and the sides of the tongue are sensitive only to sour tastes. Bitter tastes are sensed near the terminal sulcus. A prominent band of tissue runs from the inner mandibular mucosa to the underside of the tongue. The lingual frenelum (or lingual frenum) joins the inferior tongue and the mandible, perhaps stabilizing the tongue during movement. The transverse band of tissue on either side of the tongue are called the sublingual folds. This is where the ducts for the sublingual salivary glands are located. Lateral to the lingual frenelum are the ducts for the submandibular salivary glands that are hidden under the mucosa on the inner surface of the mandible.

Intrinsic Tongue Muscles

The intrinsic muscles of the tongue include two pairs of muscles running longitudinally, as well as muscles running transversely and vertically. The intrinsic and extrinsic muscles of the tongue interact in a complex fashion to produce the rapid, delicate articulations for speech and nonspeech activities. Innervation of all intrinsic muscles of the tongue is by means of the XII hypoglossal nerve.[49]

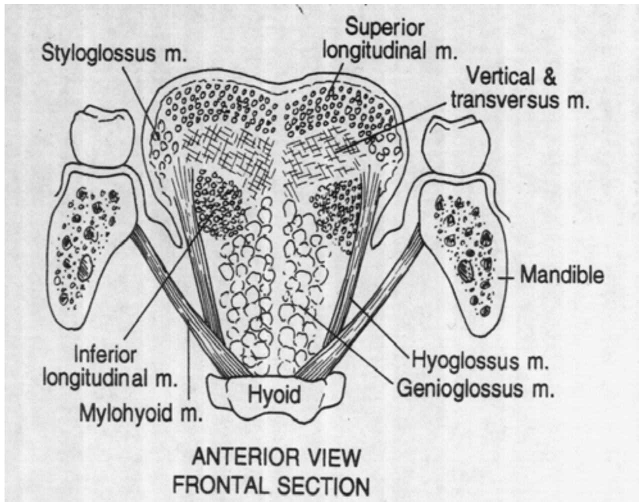

Figure 3.4 Intrinsic muscles of the tongue (anterior view, frontal section).

Superior longitudinal muscle of tongue.

This muscle courses along the length of the tongue, comprising the upper layer of the tongue. It originates from the fibrous submucous layer near the epiglottis, the hyoid, and from the median fibrous septum. Its fibers fan forward and outward to insert into the lateral margins of the tongue and region of the apex. By virtue of their course and insertions, fibers of the superior longitudinal muscle will tend to elevate the tip ot the tongue. If one superior longitudinal muscle is contracted without the other, it will tend to pull the tongue toward the side of contraction.

Inferior longitudinal muscle of tongue.

This muscle originates at the root of the tongue and corpus hyoid, with fibers coursing the apex of the tongue. This muscle occupies the lower sides of the tongue, but is absent in the medial tongue base, which is occupied by the extrinsic genioglossus muscle. The inferior longitudinal muscle will pull the tip of the tongue downward and assist in retraction of the

[49] The nervous system in the body is categorized by Roman numerals and names.

tongue if co-contracted with the superior longitudinal. As with the superior longitudinal, unilateral contraction of the inferior longitudinal will cause the tongue to turn toward the contracted side and downward.

Transverse muscle of the tongue.

This muscle provide a mechanism for narrowing the tongue. Fibers of this muscle originate at the median fibrous septum and course laterally to insert into the side of the tongue in the submucous tissue. Some fibers of the transverse muscle continue as the palatopharyngeus muscle. The transverse muscle of the tongue pulls the edges of the tongue toward midline, effectively narrowing the tongue.

Vertical muscle of the tongue.

This muscle runs at right angles to the transverse muscles and flattens the tongue. Fibers of the vertical muscle course from the base of the tongue and insert into the membranous cover. The fibers of the transverse and vertical muscles interweave. Contraction of the vertical muscles of the tongue will pull the tongue down into the floor of the mouth.

Extrinsic Tongue Muscles

The extrinsic muscles of the tongue are responsible for precise articulatory performance and the extrinsic muscles of the tongue tend to move the tongue as a unit. They appear to set the general posture for articulation, with the intrinsic muscles performing the refined perfection of the articulatory gesture.

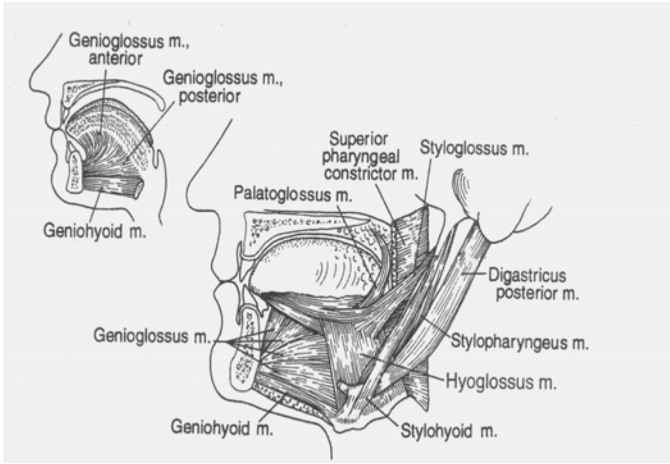

Figure 3.5 Genioglossus and related muscles.

Genioglossus muscle.

This muscle is the prime mover of the tongue, making up most of its deeper bulk. The genioglossus arises from the inner mandibular surface at the symphysis and fans to insert into the tip and dorsum of the tongue, as well as to the corpus of the hyoid bone.

The genioglossus muscle occupies a medial position in the tongue, with the inferior longitudinal muscle, hyoglossus, and styloglossus being lateral to it. Fibers of the genioglossus insert into the entire surface of the tongue, but are sparse to absent in the tip. Contraction of the anterior fibers of the genioglossus muscle results in retraction of the tongue, whereas contraction of the posterior fibers will draw the tongue forward to aid protrusion of the apex. If both anterior and posterior portions are contracted, the middle portion of the tongue will be drawn into the floor of the mouth, functionally cupping the tongue along its length.

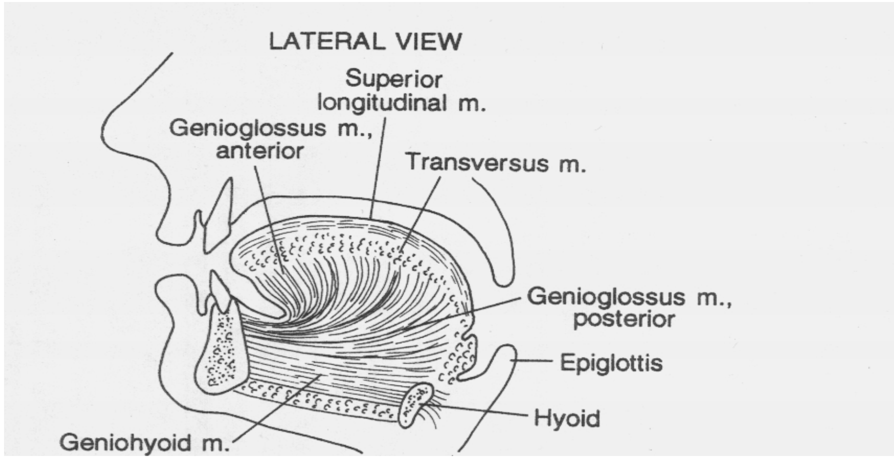

Figure 3.6 Extrinsic muscles of the tongue (lateral view).

Hyoglossus muscle.

The hyoglossus muscle arises from the length of the greater cornu and lateral body of the hyoid bone, coursing upward to insert into the sides of the tongue between the styloglossus and the inferior longitudinal muscles. The hyoglossus pulls the sides of the tongue down, in direct antagonism to the palatoglossus.

Styloglossus.

The styloglossus originates from the anteolateral margin of styloid process of the temporal bone, coursing forward and downward to insert into the inferior sides of the tongue. It divides into two portions, one intermingling with the inferior longitudinal muscle, and the other with the fibers of the hyoglossus. Contraction of the paired styloglossi will draw the tongue back and up.

Chondraglossus.

The chondraglossus is often considered to be part of the hyoglossus muscle. As with the hyoglossus, the chondraglossus arises from the lesser cornu of the hyoid, coursing upward to intermingle with the intrinsic muscles of the tongue. This location is medial to the point of insertion of the hyoglossus. The chondraglossus is a depressor of the tongue.

Palataglossus.

The palataglossus may be functionally defined as a muscle of the tongue or a muscle of the velum. Although it is more closely allied with palatal architecture and origin, it serves dual purpose of depressing the soft palate or elevating the back of the tongue.

Larynx

The primary role of the larynx is to guard the airway, but laryngeal voicing plays a vital role in the expression of both emotional and linguistic communication, including singing. The larynx is located between the trachea and the hyoid bone and consist of three unpaired and three paired cartilages bound by ligaments and lined with mucous membrane. These form the laryngeal structure.

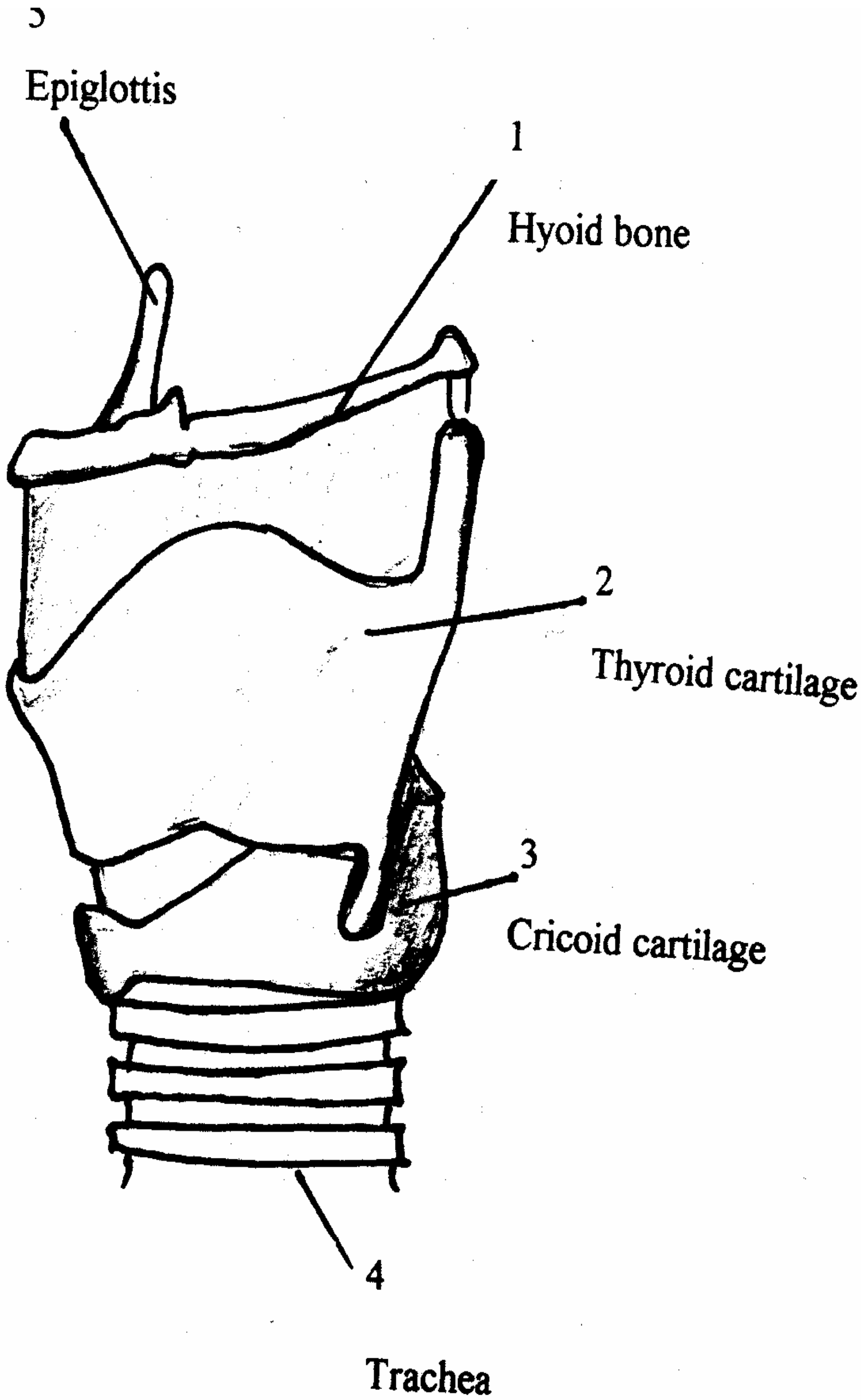

Figure 3.7 Cartilages of the larynx. (Illustration Maria Lindberg-Kransmo, 2001)

Unpaired Cartilages

Cricoid cartilage.

Superior to the trachea is the single unpaired cartilage, the cricoid. The cricoid cartilage has the shape of a signet ring with the larger part being posterior and the smaller part anterior. The low, anterior cricoid arch provides clearance for the vocal folds that will pass over that point, while the posterior elevation provides the point of union of the arytenoid cartilages. On the lateral surfaces of the cricoid cartilage are articular facets marking the point of union of the inferior horns of the thyroid cartilage. This cricoithyroid joint is a diarthrodial, pivoting joint that permits rotation of the two united structures.

Thyroid cartilage.

The single unpaired thyroid cartilage is the largest of the laryngeal cartilages. The thyroid cartilage has a prominent anterior surface made up of two plates called the thyroid laminae, joined at the midline at the thyroid angle. The oblique line is on the lateral superficial aspect of the thyriod laminae. This marks the point of attachment for the thyropharyngeus muscle and the thyrohyoid muscle.

The posterior aspect of the thyroid cartilage is open, and is characterized by two prominent sets of cornu (horns). The inferior cornua project downward to articulate with the cricoid cartilage, while the superior cornua project superiorly to articulate with the hyoid bone.

Epiglottis.

The single unpaired epiglottis is a leaflike structure that arises from the inner surface of the angle of the thyroid cartilage just below the notch, being attached there by the thyroepiglottic ligament. The sides of the epiglottis are joined with the arytenoid cartilages via the aryepiglottic folds, which are the product of the membranous lining draping over muscle and connective tissue. The epiglottis projects upward beyond the larynx and above the hyoid bone and is attached to the root of the tongue by means of the median glosso-epiglottic fold and the paired lateral glosso-epiglottic folds. This juncture produces the valleculae, an important landmark for swallowing. The epiglottis is attached to the hyoid bone via the hyoepiglottic ligament. The surface of the epiglottis is covered with mucous membrane lining, and beneath this lining on the posterior, concave surface may be found branches of the internal laryngeal nerve of X vagus that conduct sensory information from the larynx. The function of the epiglottis is to cover the opening to the larynx when swallowing, to keep food and drink out of the trachea.

Paired Cartilages

Arytenoid and corniculate cartilages.

The paired arytenoid cartilages are among the most important of the larynx. They reside on the superior posterolateral surface of the cricoid cartilage, and provide the mechanical structure that permits onset and offset of voicing. Each cartilage has two processes and four surfaces.

The apex is the truncated superior portion of the pyramidal arytenoid cartilage, and on the superior surface of each arytenoid is a corniculate cartilage, projecting posteriorly to form the peak of the distorted pyramid. The inferior surface of the cartilage is termed the base, and its concave surface is the point of articulation with the convex arytenoid facet of the cricoid cartilage.

The names of the two processes of the arytenoid give a hint as to their function. The vocal process project anteriorly toward the thyroid notch and it is these processes to which the posterior portion of the vocal folds themselves will attach. The muscular process forms the lateral outcropping of the arytenoid pyramid and as its name implies, it is the point of attachment for muscles that adduct and abduct the vocal folds.

Cuneiform cartilages.

These small cartilages are embedded within the aryepiglottic folds. They are situated above and anterior to the corniculate cartilages, and cause a small bulge on the surface of the membrane that looks white under illumination. These cartilages apparently are thought to provide support for the membranous laryngeal covering.

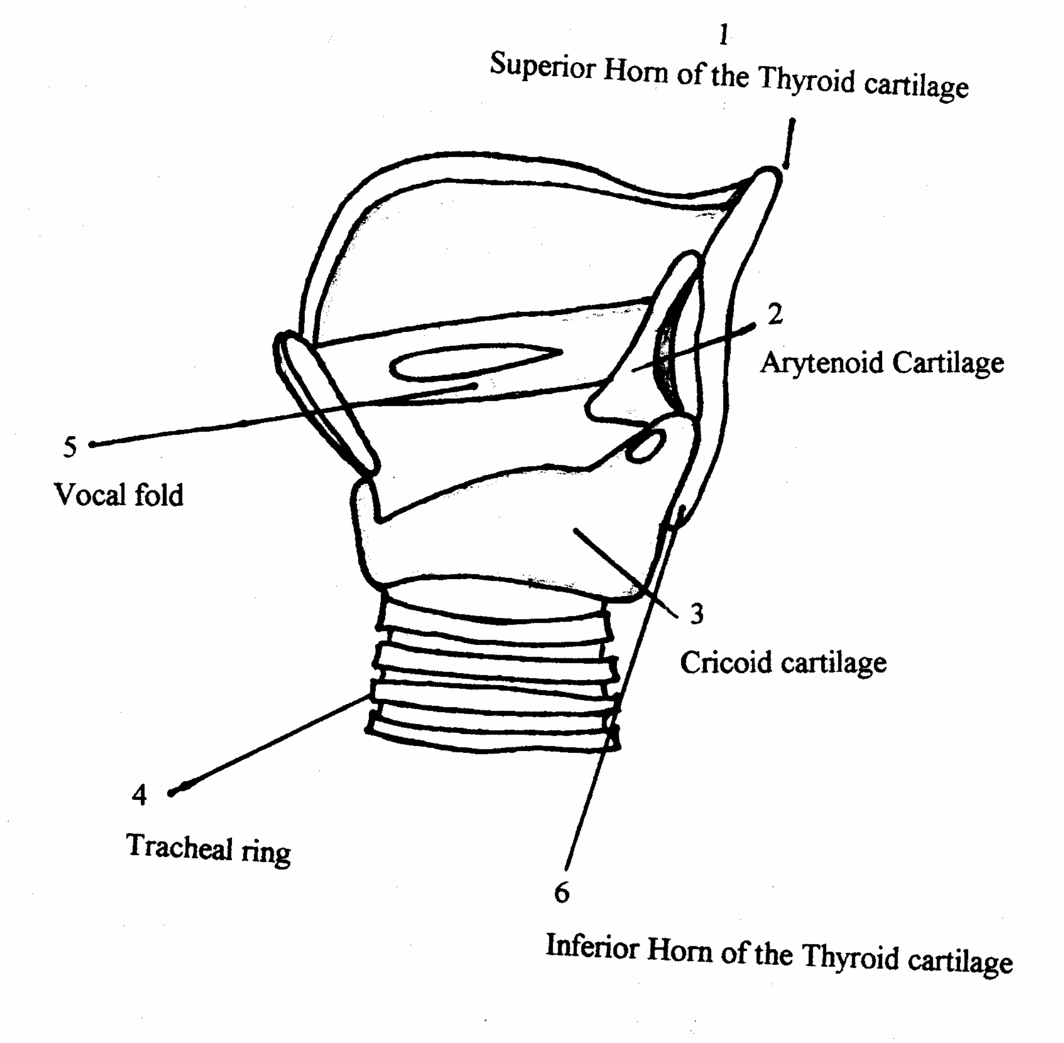

Figure 3.8 Lateral view of the larynx (cross section).
(Illustration Maria Lindberg-Kransmo, 2001)

Movement of the Cartilages

The cricothyroid and cricoarytenoid joints are the only functionally mobile points of the larynx, and both of these joints serve extremely important laryngeal functions. The cricothyroid joint is the junction of the cricoid cartilage and inferior cornu of the thyroid cartilage. These are the synovial joints that permit the cricoid and thyroid to rotate relative to each other. This joint will provide the major adjustment for change in vocal pitch.

The cricoarytenoid joint is the point of union formed between the cricoid and arytenoid cartilages. These synovial joints permit rocking, gliding and perhaps minimal rotation. The arytenoid facet of the cricoid is a convex, oblong surface, and the axis of motion is around a line projecting back along the superior surface of the arytenoid and converging above at a point above the arytenoid. This rocking action folds the two vocal processes toward each other, permitting the vocal folds to make contact. The arytenoids are also capable of gliding on the long axis of the facet, facilitating changes in vocal fold length. The arytenoids may also rotate upon a vertical axis drawn through the apex of the arytenoid, but this motion appears to be limited to extremes of abduction[50]. The combination of these gestures provides the mechanism for vocal fold adduction and abduction.

Hyoid Bone

This unpaired small bone unites loosely with the superior cornu of the thyroid cartilage, and has the distinction of being the only bone of the body that is not attached to other bone. This structure is u-shaped, being open in the posterior. There are three major elements to the hyoid bone. The corpus or body of the hyoid is the prominent shieldlike structure forming the front of the bone. The front of the corpus is convex, while the inner surface is concave. The

[50] Fink, B.R., & Demarest, R.J. *Laryngeal Biomechanics*. Cambridge, MA: Harvard University Press.(1978)

corpus is the point of attachment for the following six muscles: geniohyoid, genioglossus, mylohyoid, omomhyoid, sternohyoid and stylohyoid. The greater cornu arises on the lateral surface of the corpus, projecting posteriorly. At the junction of the corpus and greater cornu the lesser cornu is found. The following muscles will be attached to the greater and lesser cornu: the thyrohyoid, hyoglossus and middle constrictor muscle.

Pharynx

The pharynx, commonly know as the throat, is a tubelike structure approximately 12 cm in length. It has three named regions. The nasopharynx is the upper region above the soft palate, bounded posteriorly by the occipital bone and by the nasal choanae in front. The lateral nasopharyngeal wall contains the opening to the Eustachian tube. The oropharynx is located immediately posterior to the faucial pillars, bounded above by the velum and below by the hyoid bone which also is the upper boundary of the hypopharynx.

The laryngeal hypopharynx is bounded anteriorly by the epiglottis and inferiorly by the esophagus. The pharyngeal structure is lined with a muscle capable of constricting the size of the tube to facilitate swallowing and for closure of the velopharyngeal port.

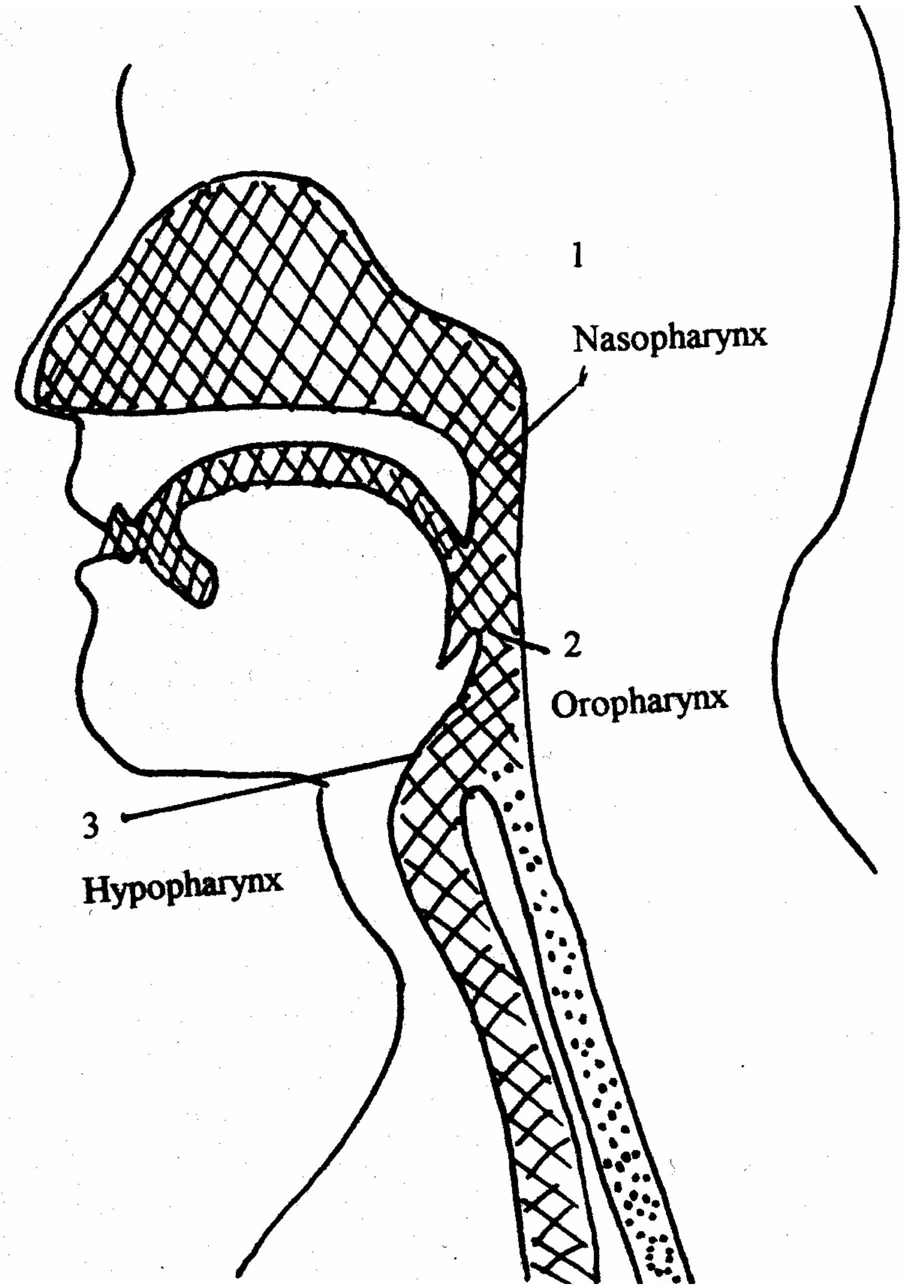

Figure 3.9 Pharynx (cross section). (Illustration Maria Lindberg-Kransmo, 2001)

Muscles of the Vocal Apparatus

Intrinsic Musculature

The intrinsic musculature is responsible for adducting, tensing and relaxing the vocal folds. This musculature has both origin and insertion on the laryngeal cartilages. There are three adductors i.e. vocal fold closure muscles, the lateral cricoarytenoid muscle, the transverse arytenoid muscle and the oblique arytenoid muscle.

The lateral cricoarytenoid muscle originates at the superior-lateral surface of the cricoid and inserts at the muscular process of the arytenoid. The muscular motion will rock the arytenoid inward and downward. According to Hirano, et al.[51] this movement may lengthen the vocal folds.

The transverse arytenoid muscle is a fiberlike band of muscle running from the lateral margin of the posterior surface of one arytenoid to the corresponding side of the other arytenoid. It pulls the two arytenoids closer together, thereby approximating the vocal folds. It provides additional support for closing of the vocal folds and for medial compression (the degree of force applied by the vocal folds at their point of contact).

The oblique arytenoid muscle is superficial to the transverse arytenoid muscle. It originates at the posterior base of the muscular process and courses up to the apex of the opposite arytenoid. With the "X" arrangement of muscles, the oblique arytenoids can pull the apex of the arytenoids medially thereby promoting adduction of the vocal folds and enforce medial compression. These muscles will also aid in pulling the epiglottis to cover the opening to the larynx.

The posterior cricoarytenoid muscle is the only abductor, i.e., opening muscle, of the vocal folds. It originates on the posterior cricoid lamina and inserts into the posterior aspect of the muscular process of the arytenoid cartilage. The posterior cricoarytenoid is a direct antagonist to the lateral cricoarytenoids. The contraction of this muscle rock the arytenoid cartilage out on its axis, and abducts the vocal folds.

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[51] Hirano, M., Kiyokawa, K., & Kurita, S. “Laryngeal Muscles and Glottic Shaping.” In O. Fujimura, (Ed.),

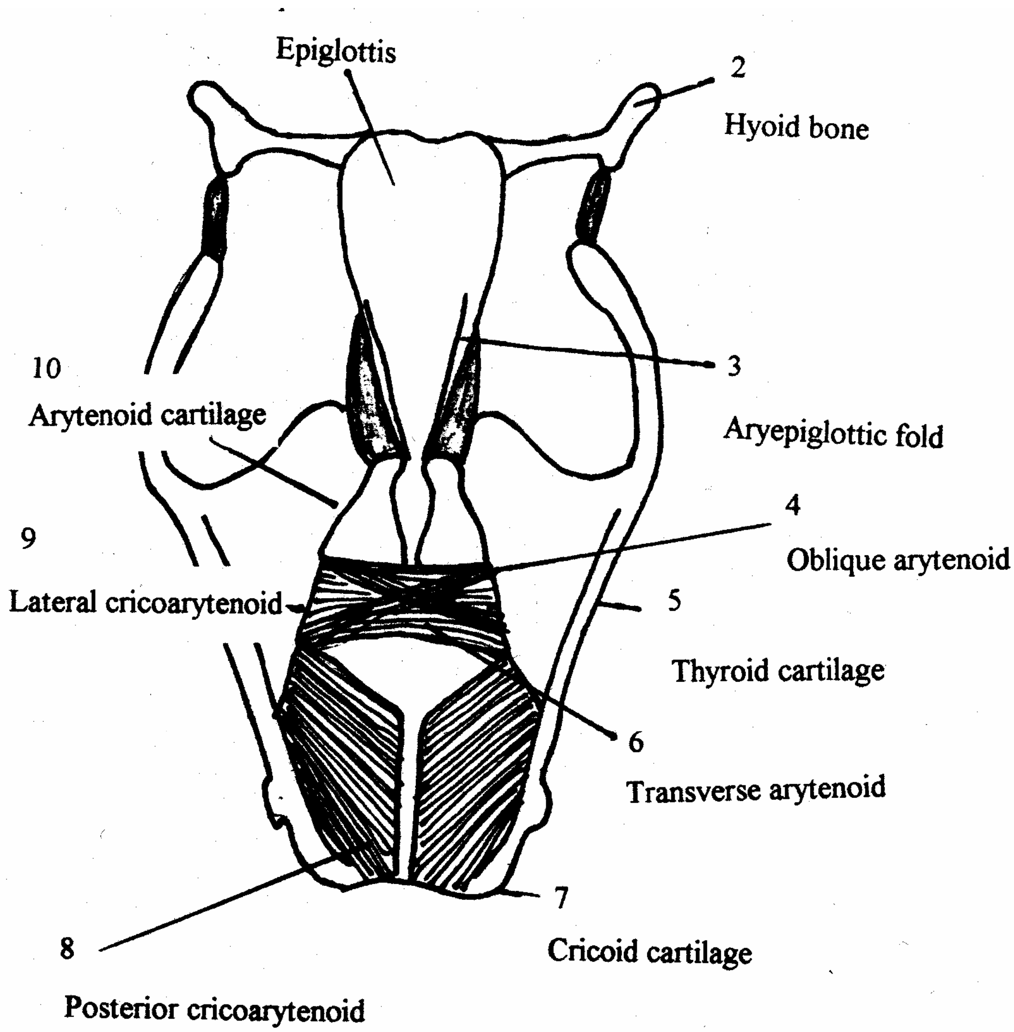

Figure 3.10 Posterior view of the larynx. (Illustration Maria Lindberg-Kransmo, 2001)

The cricothyroid muscle is the primary tensor of the vocal folds and is composed of two heads, *the pars recta* and *pars oblique*. The pars recta originates on the anterior surface of the cricoid cartilage and inserts into the lower surface of the thyroid lamina. The pars oblique originates from the cricoid cartilage lateral to the pars recta, coursing obliquely up to insert into the thyroid, between the thyroid lamina and the inferior horns. Contraction of the pars recta will effect in a downward rocking of the thyroid cartilage, rotating upon the cricothyroid joint

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Vocal Physiology: Voice Production. Mechanisms and Functions. New York: Raven Press. (1988) 49-65.

thereby stretching the vocal folds. The pars oblique's function is a forward, sliding motion, resulting in tensed vocal folds. The pars recta and obliques are responsible for the major laryngeal adjustment associated with pitch change.

The thyroarytenoid muscle is anatomically one unit, but functional evidence support differentiating the thyroarytenoid into two separate muscles, the thyrovocalis and thyromuscularis.

The thyrovocalis muscle originates from the inner surface of the thyroid cartilage and inserts into the lateral surface of the arytenoid vocal process. Contraction of this muscle will produce an antagonistic function to the cricothyroid muscle i.e. drawing the thyroid and cricoid cartilages further apart. A balanced contraction of the cricothyroid muscle and the thyrovocalis muscle will tense the vocal folds.

The thyromuscularis is lateral to the thyrovocalis in the thyroarytenoid muscle structure. It originates and inserts as the thyrovocalis muscle. The result of contraction of this muscle will be similar to that of the lateral cricoarytenoid. The vocal folds will adduct and lengthen. Contraction of the medial fibers of the thyromuscularis may relax the vocal folds.

Extrinsic Musculature

Hyoid and laryngeal elevators and depressors.

The extrinsic laryngeal musculature consist of muscles with one attachment to a laryngeal cartilage. Muscles that elevate the hyoid and larynx are the digastricus, stylohyoid, mylohyoid, geniohyoid, genioglossus, hyoglossus and thyropharyngeus muscles. Both the hyoglossus and the genioglossus are tongue depressors. They have an attachment to both the hyoid and the tongue laryngeal depressors. Muscles that depress and stabilize the larynx are; sternohyoid, omohyoid, sternothyroid and thyrohyoid muscles.

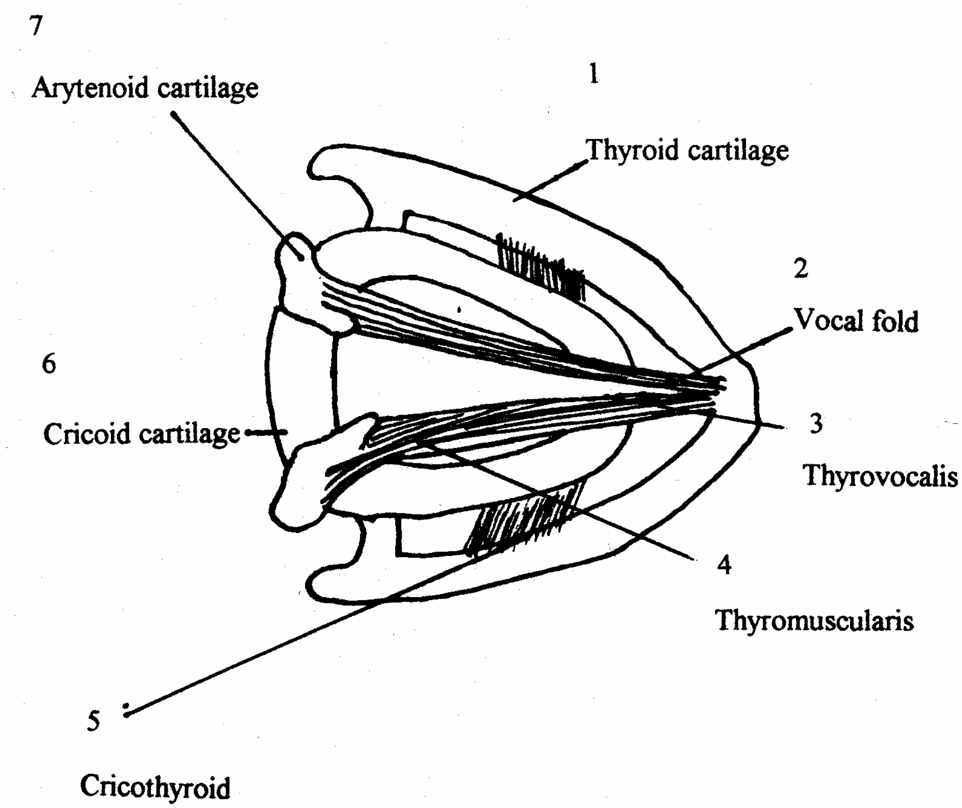

Figure 3.11 Anterior superior view of larynx, thyrovocalis, and thyromuscularis. (Illustration Maria Lindberg-Kransmo, 2001)

CHAPTER 4

TONGUE TENSION AND VOCAL HYPERFUNCTION

Tongue Tension

If the tongue is tense, the larynx may be pulled upward thereby shortening the oral pharynx, and interfering with the production of the ideal vowel sounds that have been defined as the goal for singing in the western tradition of artsong and opera. This can result in a tight, forced tone that is often under pitch. At the same time, tightening of the tongue muscles also affects the musculature of the neck which can also tighten.

Fracht and Robinson described the effects of tension on the coordinated efforts of muscles in any part of the body,

> Tension destroys not only co-ordination, but steadiness as well. When the muscles of the human body are held in tension, the result is jerky, awkward movements, aching shoulders, shaky knees, and nervous fatigue. The human body can only sustain great tension for a relatively short period of time, then there must be some degree of relaxation.[52]

One of the visible signs of neck and tongue tension in singing is trembling of the tongue. Richard Miller[53] says that tongue waving can occur when the tongue is in a nonphonetic position. The apex of the tongue belongs in contact with the inner surface of the lower front teeth for all vowels and for most consonants, unvoiced and voiced, in Western languages. The tongue should also stay there at rest. When the tongue apex is placed elsewhere during phonatory tasks, the entire body of the tongue may shake. The tongue should lie flat and free behind the lower front teeth and move with the jaw, not against it. Among all the muscles

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[52] J.A. Fracht and E. Robinson. *You Too Can Sing.* New York: Tudor Publishing Company, (1960), 16.
[53] R. Miller. "The Trembling Jaw and Tongue." *Journal of Singing* 55:5 (1999), 23-26.

involved in speech and singing, the geniohyoid is suggested to be of major importance and also the culprit in tongue tension.[54]

Adverse tongue postures include[55]:

1. Curling it slightly upward toward the hard palate in a retroflex position.
2. Pulling it directly backward from its normal contact with the inner surface of the lower front teeth.
3. Placing it below the gum ridge of the lower front teeth.
4. Elevating the sides of the tongue against the molars regardless of vowel definition.
5. Raising or lowering either side of the tongue independent of the other.
6. Grooving the tongue excessively as a uniform position for singing, regardless of vowel definition.
7. Arching the tongue so hard that it practically touches the soft palate and blocks the airflow.

One can conclude that there are complex motions required of the larynx and interconnected musculature for singing and speech which require both gross and fine adjustments. A simple gesture of laryngeal elevation must be countered with antagonistic movements by the laryngeal depressors. Arching of the tongue can elevate the larynx and also increase the tension of the cricothyroid, which is the primary tensor of the vocal folds.[56]

Correct sound production applies as much to speaking as to singing. Even though they may be motivated and supported by different areas of the brain, they still utilize the same vocal folds, larynx, breath supply and vocal tract. By gaining knowledge of the speaking voice (which many of us take for granted) and its tongue related hyperfunctions, a voice student or teacher can gain a larger understanding of the interrelationship between speech and singing.

[54] W. Hargrave. *The Genio-hyoid Vocal Interference*. Master's Thesis, North Texas State College,(1960)

[55] R. Miller. "The Trembling Jaw and Tongue." *Journal of Singing* 55:5 (1999), 23-26. L. Browning Henderson. *How to Train Singers.* West Nyack, N.Y. Parker Publishing Company Inc. (1979), 124-126.

Many speech specialists promote the use of speech therapy treatments to address specific component of the vocal apparatus, for example tongue tension, not only for speakers but for singers as well.

One of the first to integrate singing and speech was David Blair McClosky. He states that "we could obviate many functional disorders before their inception . . .by pay[ing] equal attention to our body's involvement in producing a vocal sound for either speaking or singing."[57] To be able to use the voice as an instrument of expression to its fullest extent, a greater understanding of the voice's possibilities, limitations and techniques is necessary.

By understanding vocal hyperfunctions in speech that is a result of tense or misplaced tongue, changes of speaking technique can be sought by the singing student which will promote a similar reaction, thereby correcting faulty singing technique.

Vocal Hyperfunction

Vocal hyperfunction is characterized by an excessively tense vocal fold adduction. With vocal hyperfunction the larynx rises,the tongue lifts forward and arches high, the vocal folds are tightly compressed, and the pharynx becomes constricted. The voice often sound harsh or strident and can result in tissue changes of the vocal fold, loss of voice, vocal fatigue and discomfort.

Examples of vocal misuse or abuse that could lead to or be symptoms of vocal hyperfunction are: Excessive muscular tension, inappropriate pitch, excessive loudness, excessive talking, use of voice in poor conditions (smoke, noise), poor singing technique, coughing or throat clearing, shouting, screaming or yelling, smoking, alcohol abuse, drug abuse,

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[56] J.A Seikel, D. W. King and D.G. Drumright. *Anatomy and Physiology for Speech, Language, and Hearing* 2nd ed. San Diego: Singular Publishing Group, Inc. (2000), 209.

[57] D. Blair McClosky. *Voice in Song and Speech.* Boston: The Boston Music Company (1975), 92.

inhalation of irritants or chemicals, decreased fluid intake, strenuous or unnecessary vocalization, overuse of over-the-counter medication like antihistamine or decongestants, excessive and frequent use of hard glottal attack. Long-term vocal misuse becomes vocal abuse.

Tonal Placement

Tonal placement is a term used to describe secondary sensations in the mouth, throat, bony structures of the head and, sinus cavities associated with singing. This terminology has long been used for vocal instruction though studies by Titze and others have established that these secondary sensations are the result of, and not the cause of, particular varieties in the coordination of breath and vocal fold resistance. While using this terminology of "placement" can be helpful in aiding a singer to note and remember certain sensations, an inaccurate or inappropriate image of tonal placement can also yield a problematic coordination and production. One such problematic coordination present in singers and non-singers with tongue, jaw and extrinsic laryngeal muscle tension is a posterior tone placement according to Emerich et al.[58] The posterior tone might sound more mature to the singer or speaker but can impair the efficiency of the resonator.

A good placement of the speaking voice is characterized by the sound coming "from the middle of the mouth, just above the surface of the tongue" [59] When the tongue is too far back or too forward the focus is misplaced, either to a thin *baby-voice* or a *cul-de-sac voice*. The thin voice is regarded as immature and lacks enough oral resonance. The forward *baby-voice* is characterized by high anterior carriage of the tongue and a very small opening of the lips and the jawbone. It can be common in both men and women.

[58] K. A. Emerich, M.M. Barody, L.M. Carroll and R.T. Sataloff. "The Singing Voice Specialist." *Vocal Health and Pedagogy* (San Diego: Singular Publishing Group, Inc. 1998), 322.

[59] D.R. Boone. *Is Your Voice Telling on You?* 2nd Ed. San Diego: Singular 1997), 71.

When the tongue is elevated and retracted in the back of the mouth, the sound can appear garbled and back-focused as characterized by the television character Alf. This *cul-de-sac voice* is found in people with oral apraxia, some cerebral palsied children, some people with bulbar or pseudobulbar-type lesions who have pharyngeal focus to their vocal production, individuals producing this for functional reasons; and deaf children. The *cul-de-sac voice* is produced by the deep retraction of the tongue into the oral cavity and hypopharynx. The body of the tongue obstructs the escaping airflow and sound waves generated from the larynx. For people with muscle disorders the problem can be very hard to correct, but for individuals with "normal" functionality there are exercises that are helpful in adjusting the sound.

Anterior focus, *the baby-voice* with faulty tongue placement, can often be corrected by producing, on comfortable pitch, back-of-the-mouth sounds by the tongue in rapid succession. Some facilitating approaches are:[60]

1. Kuh-Kuh-Kuh-Kuh-Kuh. Repeat five times. Alternate with Kah, Guh and Gah.
2. Put stress on back consonants "K" and "G" and back vowel sounds "ah" and "uh"

Other facilitating approaches are:

1. Change of loudness: When the resonance problem is part of a general picture of psychological withdrawal in particular situations, efforts to increase voice loudness are appropriate for overall improvement of resonance.
2. Digital manipulation: This is especially helpful when the pitch of the voice is too high or the quality is breathy. A light touch on the larynx will remind of a lower placement, conducive to lesser tongue tension and better sound.
3. Establishing new pitch: The thin voice is perceived by listeners to be drastically lacking authority. Frequently, the pitch is too high. Efforts to lower the voice pitch often have a positive effect on resonance, and can also lower the tongue and larynx to a more beneficial position.
4. Focus: The babylike voice may disappear with greater posterior tongue carriage.

[60] D.R. Boone , S.C McFarlane. *The Voice and Voice Therapy*. 5th Ed. (Englewood Cliffs, NJ: Prentice Hall 1994), 290-291.

5. Open-mouth: The restrictive oral tendencies of a thin-voice speaker may be effectively reduced by developing greater oral openness by releasing the jaw and allow the tongue to relax.

6. Relaxation: If the thin vocal quality is highly situational and the obvious result of tension in the tongue, relaxation approaches may be helpful.

7. Respiration training: Sometimes direct work on increasing voice loudness requires some work increasing control of the airflow during expiration.

8. Visual feedback: Individuals whose anterior resonance focus is related to situational tensions may use feedback apparatuses, for example a mirror , video or tape recorder to become aware of their varying states of tension.

9. Yawn-sigh: The yawn-sigh approach is an excellent way of developing a more relaxed, posterior tongue carriage and is used both by speech therapists and voice teachers.

Posterior focus, the *cul-de sac voice*, can be corrected by using these exercises on a comfortable pitch.[61]

1. Whisper rapidly Peep-peep-peep-peep-peep. Switch to Pipe-pipe-pipe-pipe-pipe. Repeat 4-5 times.

2. Rapidly whisper voiceless "TH-words" like "THIS" or "THAT" in series of five words at a time. Repeat 4-5 times.

3. Rapidly whisper "S-words" like "SEE" or "SAT" in series of five words at a time. Repeat 4-5 times.

4. In light voice repeat the whispered series of Peep, Pipe, This, That, See and Sat.

Other facilitating approaches are:

1. Auditory feedback: If in search for a better voice, the individual is able to produce a more forward, oral-sounding one, this should be contrasted with his or her *cul-de sac voice* by listening to auditory feedback.

2. Focus: The forward focus in resonance required to place the voice in the "facial mask" makes the approach a useful one for patients with a cul-de sac focus. High front vowels and front-of-the-mouth consonants are particularly good practice sounds to use with the place-the-voice approach.

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[61] D.R. Boone , S.C McFarlane. *The Voice and Voice Therapy*. 5th Ed. Englewood Cliffs, NJ: Prentice Hall (1994), 291-292.

3. Nasal-glide stimulation: This helps to get a forward placement of the tongue and the sound and can be used in conjunction with focus.

4. Relaxation: Posterior tongue retraction during moments of stress is often a learned response to tension. An individual who can learn a more relaxed positioning of the overall vocal tract may be able to reduce excessive tongue retraction.

5. Tongue protrusion: Because the tongue is extended outside of the mouth and the pitch is elevated, the base of the tongue is pulled forward and out of the oral pharynx and this is emphasized with the [i] vowel. This eliminates the retracted tongue position that produces back quality.

6. Visual feedback: Posterior focus of voice resonance may for some individuals be situationally related to tension. Feedback from a video or music tape recording is often a useful tool to monitor the individual's varying states of tension. For example tongue root tension occurring in situations of public speaking/singing.

CHAPTER 5

ARTICULATION: THE NATURE AND FORMATION OF VOWELS AND CONSONANTS

English Pronunciation[62]

Every language has its peculiarities of pronunciation of both vowels and consonants. Quite often a singer spends more time on studies of foreign language pronunciation than on their native language. In reality an equal amount of time should be spent on the formation and execution of vowel and consonant sounds of the native language. According to Moriarty[63], American spoken language tends to be imprecise with back produced vague vowels, unclear articulation of consonants, diphthongs and triphthongs in wrong places, and a tendency to slur over unstressed syllables.

When singing, the duration of the phonetic position is longer than in speech. This suggests that the adjustment of the tongue, the lips, the velum, the mandible and the vocal tract should be more distinct and precise. The vowel postures, described here for the formation of sounds (using IPA), are not static but resembles what phoneticians describe as the optimal posture of the articulators. Miller refers to good tongue position as neutrally placed. The tongue, in its relaxed position, will touch the lower teeth. The upper and lower rows of teeth and upper and lower jaw will be separated, although lips can be closed. "This central position of the tongue and the mandible is home base for the speech mechanism."[64]

With that in mind, a singer with tongue tension would be wise to start the retraining work in their native language – for most Americans that would be English. Moriarty suggests "...often

[62] J. Wall. *International Phonetic Alphabet for Singers.* Pst ... Inc.: Dallas. (1989)

[63] J. Moriarty. *Diction: Italian, Latin, French, German...the Sounds and 81 Exercises for Singing Them*. 2nd ed. E.C.Schirmer Music Company, Boston, MA (1975), xi.

[64] R.Miller. *The Structure of Singing*. New York: Schirmer Books, (1996), 69.

vocal production makes a startling and immediate improvement when the articulations of vowels and consonants become clear."[65]

In this section, vowels and consonants that require tongue involvement will be identified and listed with their respective specific articulation coordination. Logic would have it, that an individual singer with tongue tension, should systematically go through this list of tongue related articulations, and check with either a voice teacher or speech therapist as to which sounds need to be relearned for an efficient production that is devoid of tongue tension.

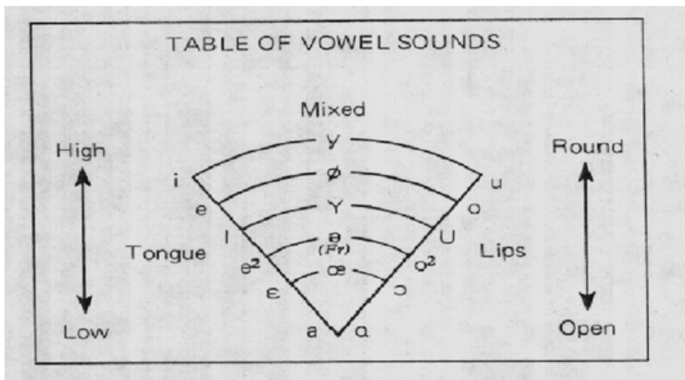

Figure 5.1 Vowel chart. (Copyright E.C.Schirmer Music Company, a division of ECS Publishing, Boston, MA. Used by permission.)

Tongue and Forward Vowels

The forward vowels are those produced with the arch of the tongue forward in the mouth, near the teeth ridge or hard palate. For each forward vowel, the tip of the tongue touches the back of the bottom front teeth. The lips are in a neutral position, neither spread nor rounded. The soft palate is raised, closing off the nasal passage. Vowels are essentially produced the same in speech and in singing. One difference is that the jaw often is lower in singing than in speech, therefore the tongue needs to move more forward in the mouth to maintain vowel integrity.

[i]

[65] J. Moriarty. *Diction: Italian, Latin, French, German...the Sounds and 81 Exercises for Singing Them*. 2nd ed. E.C.Schirmer Music Company, Boston, MA (1975), xii.

The high point of the tongue is forward in the mouth, close to the teeth ridge, which makes **[i]** a closed, forward vowel. The tip of the tongue touches the back of the bottom front teeth. The sides of the tongue laterally touch the inside of the upper molars.

[ɪ]

The high point of the tongue is forward in the mouth, close to the teeth ridge, slightly lower than ee **[i]**. The tip of the tongue touches the back of the bottom teeth. The sides of the tongue laterally touch the insides of the upper molars.

[e]

For closed **[e]**, the tip of the tongue touches the back of the bottom teeth. The front of the tongue is raised and brought forward in the mouth, elevated to a point close to the roof of the mouth but lower than **[ɪ]**. The sides of the tongue laterally touch the upper side molars. In American English, the diphthong **[eɪ]** is consistently used in place of the pure **[e]** and may be considered an allophone of **[e]**. The diphthong **[eɪ]** is created when a pure **[e]**is released with a quick upward movement of the tongue to **[ɪ]**, thus creating the diphthong.

[ɛ]

For **[ɛ]** the front of the tongue is arched, brought forward in the mouth, and elevated to a point midway to the roof of the mouth, lower than **[eɪ]**. The tip touches the back of the bottom teeth. The sides of the tongue touch the inside of the upper teeth.

[æ]

The high point of the tongue is forward in the mouth, slightly lower that for **[ɛ]** . The tip of the tongue touches the back of the bottom teeth. The sides of the tongue may or may not touch the upper back teeth depending upon the speaker's personal articulation habit, but for fuller resonance in singing, the sides of the tongue do not touch the upper back teeth. Because the space between the tongue and the roof of the mouth is open, and the high point of the tongue is forward, this vowel is called an open, forward vowel.

[a]

The high point of the tongue lies lower in the mouth for *bright ah* **[a]** than for **[æ]**, but higher than for the back *dark ah*. The tongue tip rests behind the back of the bottom teeth. The space between the tongue and the roof of the mouth is the most open of the forward vowels. In general, for American English the *bright ah* **[a]** is almost always part of a diphthong for example **[aɪ]** and seldom used in isolation. (It is part of the New England dialect)

Tongue and Back Vowels

Those vowels which are articulated with the high point of the tongue in the back of the mouth are called the back vowels.

[u]

The high point of the tongue is in the back of the mouth close to the soft palate. The tip of the tongue touches the back of the bottom front teeth. Lips are very rounded. It is referred to as closed **[u]**.

[ʊ]

The high point of the tongue is in the back of the mouth close to the soft palate. The tip of the tongue touches the back of the bottom front teeth. The lips are rounded but more lax than **[u]**. It is referred to as open **[ʊ]**.

[o]

The back of the tongue is elevated toward the mid-back roof of the mouth, but less raised than for **[ʊ]**. The tip of the tongue touches the bottom front teeth. In American English diphthongal **[o ʊ]** is consistently used in place of the pure **[o]** and may be considered an allophone of **[o]**. For diphthong **[o ʊ]** the closed **[o]** is released and there is a greater rounding of the lips, followed by a quick upward movement of the back of the tongue for the **[ʊ]**, thus creating the diphthong.

[ɔ]

The back of the tongue is slightly raised toward the roof of the mouth, but not a high as for **[o]**. The tip of the tongue touches the back of the bottom front teeth and the lips are rounded.

[ɑ]

The body of the tongue is in a low position for this open back vowel. The tip of the tongue touches the back of the bottom teeth. Lips are open in an oval position.
The tight tongue and jaw are conditions that adversely affect the enunciation of *ah* **[ɑ]**.
The exclamation, *Ah!* can be a good key word to use.

Tongue and Central Vowels

The central vowels in English are those vowels which are produced with the high point of the tongue centrally located in the mouth. Each central vowel has a specific relationship to stress within a word. Stress occurs when a speaker changes the loudness and duration of pitch of a particular syllable. In unstressed syllables, the degree of emphasis is changed by altering the vowel itself.

[ʌ]

The middle of the tongue is in a low position, slightly arched back of the center of the mouth, which designates **[ʌ]** as a mid, central vowel. The tip touches the back of the bottom front teeth. The sound **[ʌ]** is used only in syllables of primary or secondary stress.

[ə]

The high point of the tongue is located in the center of the mouth, differing from the stressed **[ʌ]**, which has the high point of the tongue back of center. The tip of the tongue touches the back of the bottom front teeth.

[ə]

This the most frequently used sound in the English language, occurring frequently in unstressed syllables. Any English vowel may be represented by schwa in an unstressed syllable.

[ɝ]

This sound is unique to American English pronunciation for the written letter R. The tip of the tongue is retracted and raised to a central position in the mouth. The suspended tongue tips points toward the boundary of the teeth ridge and hard palate. The sides of the tongue touch the side teeth. Air passes across the center of the tongue. This sound is a vowel blended with the sound of the consonant **[r]**. It is only used in syllables of primary or secondary stress.

[ɚ]

The tip of the tongue is retracted and raised to a central position in the mouth. The suspended tip points toward the teeth ridge and hard palate. The ides of the tongue touch the side teeth. Air passes across the center of the tongue. It has the same sound as the stressed **[ɝ]**, it is more lax and shorter in duration. It is only used in unstressed syllables and is called a hooked schwa.

[ɜ]

The tongue is arched with the high point in a mid-central position in the mouth. The middle of the tongue is higher than for **[ʌ]** or **[ə]**. The tip of the tongue touches the back of the bottom front teeth. The tip is not retracted for this sound. The r-less **[ɝ]** is used only in stressed syllables and is usually spoken by Eastern, Southern and British speakers.

Tongue in Diphthongs and Glides

A diphthong is produced when there is movement of the tongue,lips or jaw during the production of a vowel, usually with a quick, gliding motion of the tongue to a higher position. The two vowel sounds of a diphthong are blended into a sound perceived as a single unit. There are six diphthongs in English, four are phonemes and two are allophones. The difference between the phonemes and the allophones is that if the glide is omitted in the phonemes, the meaning of the word changes. The two allophones **[oʊ]** and **[eɪ]** are found under **[o]** and **[e]**.

[aɪ]

The tongue begins in a low position for [a], then quickly moves to a high forward position for **[ɪ]**. Only the blade and middle part of the tongue move upward to create the move to **[ɪ]**. The tip of the tongue remains behind the back of the bottom teeth.

[aʊ]

The tongue begins in a low position for **[a]**, then quickly moves to a high, back position for **[ʊ]**. Only the back of the tongue moves to create the move to **[ʊ]**. The tip of the tongue remains behind the back of the bottom front teeth.

[ɔɪ]

The tongue begins in a low, back position for *aw* **[ɔ]**, then quickly moves to a high, forward position for *ih* **[ɪ]**. The tip of the tongue remains behind the back of the bottom front teeth. The substitution of the diphthong **[aɪ]** for **[ɔɪ]** occurs occasionally in North American speech. The lips do not round and the jaw is not sufficiently dropped when beginning the diphthong.

[ju] - Glide

The tongue begins in a high, forward position for the sound of *yot* [j], then quickly glides to a high, back position for [u]. The tip of the tongue remains behind the back of the bottom front teeth. This diphthong differs from the other three mentioned above, the glide portion occurs at the beginning instead of at the end of the diphthong.

Tongue and Consonants

The consonant is a speech sound that is formed when the articulators interrupt the flow of air through the vocal tract. The points of the vocal tract where breath interruption occurs to produce consonants are : the lips, teeth, tongue, teeth ridge, hard palate, soft palate and glottis. Only the consonants with tongue involvement will be mentioned here.

The classification of voicing indicates whether the consonant is produced with vocal fold vibration (voiced) or without vocal fold vibration (unvoiced). There are several pairs of consonants (called cognates) which have the same place and manner of articulation. Cognates are differentiated only by voicing.

Stop plosive consonants [t] *and* [d]

The tongue tip touches the teeth ridge to stop the air flow through the oral passageway. The soft palate is raised, closing the nasal passageway. Air pressure builds up and then is released explosively. [t] is unvoiced and [d] is voiced. When d follows an unvoiced consonant sound, it is pronounced as unvoiced t, for example clipped and kicked.

Stop plosive consonants [k] *and* [g]

The air flow stops as the back of the tongue lifts to touch the soft palate, closing off the oral passageway and the soft palate is raised, closing off the nasal passageway. Air is then plosively released by the quick downward movement of the back of the tongue. [k] is unvoiced and [g] voiced.

Nasal consonant [n]

The tongue tip touches the teeth ridge to stop the flow of air through the oral cavity. The soft palate lowers to permit air to pass through the nasal cavity. This voiced consonant can be fully vibrated when the tip of the tongue lifts to gently touch the teeth ridge and the teeth.

Nasal consonant [ŋ]

The back of the tongue is raised to touch the soft palate and stop the flow of air through the oral passageway. The soft palate lowers to permit air to pass through the nasal cavity. This consonant is voiced and can be taken advantage of for good resonance, brilliant tone and carrying power.

The fricative consonants [θ] *and* [ð]

The upper front teeth and tongue touch. Air passes between the tongue blade and upper teeth. The sides of the tongue touch the upper molars and the soft palate is raised, closing the nasal passageway. The [θ] is unvoiced and [ð] is voiced.

The fricative consonants [s] *and* [z]

Either the tip of the tongue is near the teeth ridge or the blade of the tongue is near the teeth ridge with the tip behind the bottom front teeth. Air flows between the teeth and tongue. Sides of the tongue touch the upper molars. The soft palate is raised, closing nasal passageway. The different tongue placements will produce the same acoustic results. [s] is unvoiced and [z] is voiced.

The fricative consonants [ʃ] *and* [ʒ]

The sides of the tongue laterally touch the side teeth. The tongue tip is pointed either toward the back of the teeth ridge or lower gum ridge. Air shoots out over the tongue and between the front teeth. The soft palate is raised, closing the nasal passageway.
[ʃ] is unvoiced and [ʒ] is voiced.

The lateral consonant [l]

The tip of the tongue raises to touch the teeth ridge. The sides of the tongue lower to permit the flow of air over the sides of the tongue and out the sides of the mouth. The [l] is voiced. In English there are four allophones of [l].

> The clear [l] which is made with the tongue tip touching the teeth. It is used preceding forward vowels and diphthongs for example lemon, leap, lit.
>
> The dark [l], or alveolar [l]. The tip of the tongue touches higher up on the teeth ridge. In General American it is often used in the middle of words or at the end, for example full, wall, milk, truly.
>
> The dental [l] is used by Americans before th, for example wealth, health.

The final *le* in words is *vowelized* or *syllabized l*. The syllabic *l* does not produce a freely vibrating tone on sustained notes, for example little, able, bottle. To remedy that problem it is advisable to put in an [ə] before the l-sound, bottle sung as [ˈbɑ təl].

The gliding consonant [r] (American)

This consonant is not the same as the flipped or the rolled [r]. It is used in American English. The vocal folds vibrate as the sides of the tongue press against the inside of the upper back teeth. The tongue tip is retracted and pointed upward just behind the teeth ridge. The soft palate is raised, closing the nasal passageway. When [r] follows a vowel in the same syllable, it can sometimes be heard as a separate consonant as in car or as part of the vowels[ɝ]and [ɚ] as in murder. The [r] is voiced.

The gliding consonant [j]

The tongue tip touches the back of the bottom front teeth. The blade of the tongue moves to a high, arched position, close to the hard palate, similar to the vowel [ɪ], then quickly shifts to the vowel which follows. The soft palate is raised. The [j] is voiced.

The gliding consonants [hw] *and* [w]

The tongue tip is behind the back of the bottom front teeth. The back of the tongue is raised. The lips are rounded and ready to move into the next sound. The soft palate is raised, closing off the nasal passageway. [hw] is unvoiced and [w] is voiced.

The Affricates (combination consonants) [tʃ] *and* [dʒ]

The tongue blade touches the teeth ridge and the sides of the tongue touch the upper side teeth to form a stop-plosive sound. The tongue tip then moves to a fricative position. The soft palate is raised closing off the nasal passageway. [tʃ] is unvoiced and [dʒ] is voiced.

Comparing French, German and Italian Pronunciation with English[66]

This section will identify the differences in vowel production between English and French, German and Italian. Once pronunciation of vowels and consonants in the native language is mastered, there will be a strong foundation for mastering the articulations of other languages. The three major singing languages will pose new or similar articulation needs as

[66] J. Moriarty. *Diction: Italian, Latin, French, German...the Sounds and 81 Exercises for Singing Them.* 2nd

English did before retraining. The same precise approach used for mastering efficient articulation (especially the ones involving the tongue) in the native language should be undertaken for foreign languages. This approach should pinpoint the particular articulation inflicting tension.

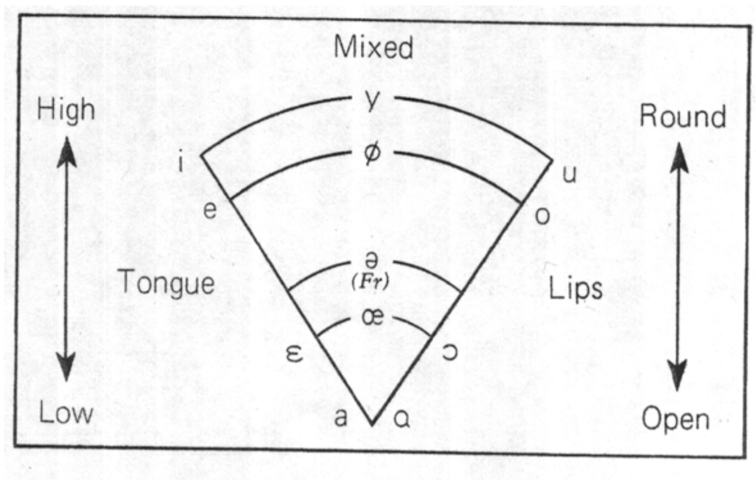

Figure 5.2 French vowels, showing relative height, roundness, opening and closure. (Copyright E.C.Schirmer Music Company, a division of ECS Publishing, Boston, MA. Used by permission.)

Forward Vowels

[i]

The vowel **[i]** has exactly the same sound in French and German, the Italian vowel is slightly different compared to the American English **[i]** where **[i]** many times is spoken as a diphthong. The high tongue position at the end of what Moriarty calls "the English diphthong **[ɪi]**" is actually the tongue position of the French and German **[i]**. The tongue position for Italian **[i]** is neither as high as the French-German vowel, nor as low as the beginning of the English vowel. The French-German **[i]** is made with more of a smile.

[e]

This vowel has no direct counterpart in English. The tip of the tongue touches the back of the bottom teeth. The front of the tongue is raised and brought forward in the mouth, elevated to a point close to the roof of the mouth but lower than **[ɪ]**. The sides of the tongue laterally touch

ed. E.C.Schirmer Music Company, Boston, MA (1975) the upper side molars. It is important to have a high arch of the central part of the tongue but not as high as the **[i]** in German and French.

[ɪ]

This vowel is nearly identical in English and German, just pronounced with a bit more of a smile. This vowel does not exist in French or Italian.The high point of the tongue is forward in the mouth, close to the teeth ridge, slightly lower than ee **[i]**. The tip of the tongue touches the back of the bottom teeth. The sides of the tongue laterally touch the insides of the upper molars.

[ɛ:]

This vowel occurs in the German spelling as ä. The only closed **[e]** sound in Italian is **[ɛ:]**, a relaxed, high **[e]** which is neither so high as French-German **[e]**, nor as open as **[ɛ]**. French has no**[ɛ:]**, only the high **[e]** which sound closer to an American **[i]** . The high point of the tongue is forward in the mouth, slightly lower that for **[ɛ]** . The tip of the tongue touches the back of the bottom teeth. The sides of the tongue may or may not touch the upper back teeth depending upon the speaker's personal articulation habit, but for fuller resonance in singing, the sides of the tongue do not touch the upper back teeth.

[ɛ]

This vowel sound is common to English, Italian, French and German. One must pay attention not to spread it to wide as in **[æ]**.For **[ɛ]** the front of the tongue is arched, brought forward in the mouth, and elevated to a point midway to the roof of the mouth, lower than **[eɪ]**. The tip touches the back of the bottom teeth. The sides of the tongue touch the inside of the upper teeth.

[a]

The vowel **[a]** is peculiar to French . German and Italian do not use it at all. It is a very bright vowel, similar to **[ɑ]** but pronounced with more of a smile. The body of the tongue is in a low position for this open back vowel. The tip of the tongue touches the back of the bottom teeth. Lips are open in an oval position. The tight tongue and jaw are conditions that adversely affect the enunciation of *ah* **[ɑ]**.

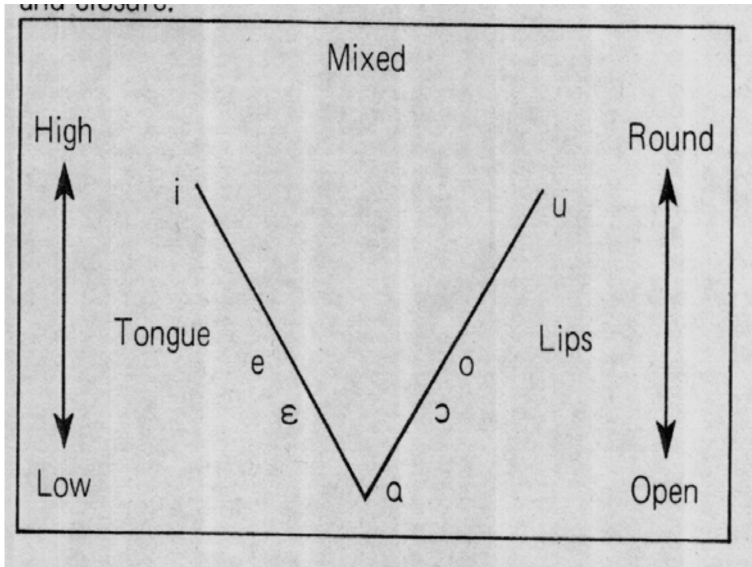

Figure 5.3 Chart of Italian vowels, showing relative height, roundness, opening and closure. (Copyright E.C.Schirmer Music Company, a division of ECS Publishing, Boston, MA. Used by permission.)

Back Vowels

[u]

The vowel [u] in French and German takes up where American vowel leaves off going further forward. It is very intense and is pronounced with much more rounding of the lips and a slightly higher tongue position. The Italian [u] does not have the exaggerated rounding of the French-German vowel, but it does have more lip rounding than the American vowel.

[ʊ]

This vowel does not occur in Italian or French, but does occur in German. One must pay attention to NOT pronounce this vowel sound in a guttural fashion, this vowel needs lip rounding.

[o]

The round vowel [o] exist as closed o in French and German and has to be round and produced with puckered lips. The Italian *o* is not as high and round as in French and German, but more relaxed.

[ɔ]

Open *o* is the same in English, French, German and Italian. In English this sound tends to become a diphthong when it occurs before certain vowels, that is not the case in the other languages.

[ɑ]

This is the most relaxed vowel heard in Italian, as in *sala, lana, pane*. No matter where it is found it is always pronounced the same way. In French there is minimal difference in the spoken language between [a] and [ɑ]. When singing there is a subtle difference and it will be most obvious when the two vowels occur in close succession. In German there is a differentiation between spoken long [ɑ] and short [ɑ] but there is no difference when singing.

Central Vowels

[ʌ]

The vowel [ʌ] does not exist in French, German or Italian.

[ə]

French is a very forward-placed language, consequently, the neutral vowel also sounds forward. This vowel need more rounding of the lips to sound French. The German *schwa* does not employ any rounding of the lips and the center tongue depression, used in the English word *but*, is eliminated. Standard Italian has no neutral vowels, although some Italian dialects do.

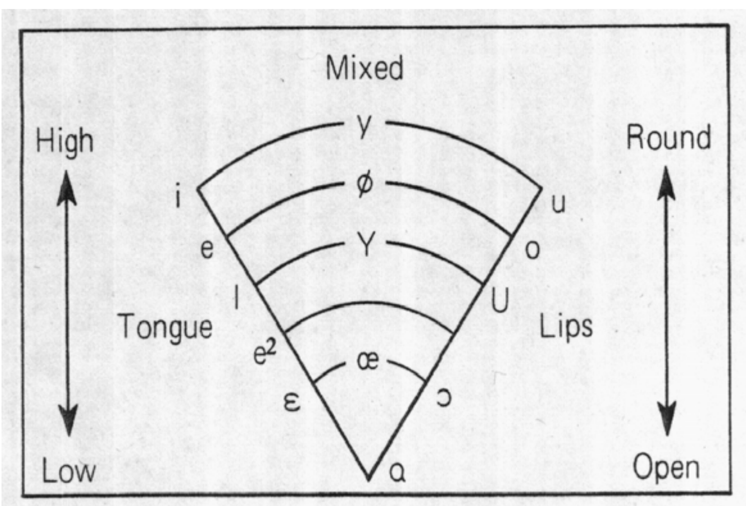

Figure 5.4 Chart of German vowels, showing relative height, roundness,opening and closure. (Copyright E.C.Schirmer Music Company, a division of ECS Publishing, Boston, MA. Used by permission.)

Mixed Vowels

French and German have a third category of vowels. They are called mixed vowels because they employ the tongue position of one vowel simultaneous with the lip position for another.

[y]

Shape the lips for [u] and pronounce [i] with the high point of the tongue forward in the mouth, close to the teeth ridge. The tip of the tongue touches the back of the bottom front teeth. The sides of the tongue laterally touch the inside of the upper molars. The vowel heard is the German *ü* as in *früh* or the French *fut*.[ø] Shape the lips for [o] and pronounce [e]. The tip of the tongue touches the back of the bottom teeth. The front of the tongue is raised and brought forward in the mouth, elevated to a point close to the roof of the mouth but lower than [ɪ]. The sides of the tongue laterally touch the upper side molars. The sound produced is the German *schön* and the French *feu.*

[œ]

Shape the lips for [ɔ] and pronounce [ɛ]. The front of the tongue is arched, brought forward in the mouth, and elevated to a point midway to the roof of the mouth, lower than [eɪ]. The tip touches the back of the bottom teeth. The sides of the tongue touch the inside of the upper teeth. The resultant vowel is in the German *könnt* and in the French *coeur*.

[ʏ]

Shape the lips for [ʊ] and pronounce [ɪ]. The high point of the tongue is forward in the mouth, close to the teeth ridge, slightly lower than [ɪ]. The tip of the tongue touches the back of the bottom teeth. The sides of the tongue laterally touch the insides of the upper molars.
The resulting vowel in German is as in *Glück*. This vowel sound does not exist in French.

Consonants

Stop plosive consonants [t] *and* [d]

The English and German consonants are alveolar [t] and [d]. The French and Italian are dental [t] and [d]. This sound is dryer than the English-German sound.

Stop plosive consonants [k] *and* [g]

These two consonants are formed the same way in all four languages. The English-German use a puff of air between consonant and vowel, this does not happen in French or Italian. This lack is more obvious with the unvoiced consonant [k].

Nasal consonant [n]

In French, German and Italian the tip of the tongue is placed against the back of the upper teeth. This dental [n] will be more resonant.

Nasal consonant [ŋ]

This consonant occurs in German and Italian but not in French.

The fricative consonants **[T]** *and* **[D]**

These do not exist in French, German or Italian other as in borrowed words.

The fricative consonants **[s]** *and* **[z]**

In spoken German these consonants are dental. The tip of the tongue is on the back of the upper teeth. Air flows between the teeth and tongue. Sides of the tongue touch the upper molars. The soft palate is raised, closing nasal passageway. This causes a consonant with to much hiss for singing. Therefore it is better to produce the German [s] and [z] as one would in singing English, French or Italian.

The fricative consonants [ʃ] *and* [ʒ]

There is a subtle difference between the [ʃ] consonant in English and Italian on the one hand, and French and German on the other. In French and German the sides of the tongue laterally touch the side teeth. The tongue tip is pulled back away from the lower front teeth. Air shoots out over the tongue and between the front teeth. The soft palate is raised, closing the nasal passageway and the lips are more puckered. The [ʒ] does not exist in German or Italian, except in borrowed words.

The fricative consonant [ç]

This consonant does not exist in French or Italian. The tongue is arched forward in the mouth, the tip of the tongue is against the back of the lower teeth. The sound is caused by the friction of air passing between the arched tongue and the hard gum ridge directly in back of the upper teeth. If [ç] is voiced it becomes [j].

The lateral consonant [l]

In French, German and Italian the [l] is dental. The tip of the tongue rests on the back of the upper teeth. It is completely relaxed and quite high and forward in the mouth. There is no depressing or arching. This sound is used in all positions of a word.

The gliding consonant [r] *and the flipped or trilled* [r]

The gliding [r] is never used in French, German or Italian. The rolled [r] is produced with the tongue tip just back of the teeth ridge. The vocal folds vibrate as the tongue tip press against the ridge, this uses more air than an American [r]. The soft palate is raised, closing of the nasal passageway.

The gliding consonant [j]

Does occur in French but not in German or Italian. The tongue tip touches the back of the bottom front teeth. The blade of the tongue moves to a high, arched position, close to the hard palate, similar to the vowel [ɪ], then quickly shifts to the vowel which follows. The soft palate is raised. The [j] is voiced.

The gliding consonants [hw] *and* [w]

The [w] occurs in French but not in German or Italian. The tongue tip is behind the back of the bottom front teeth. The back of the tongue is raised. The lips are rounded and ready to move into the next sound. The soft palate is raised, closing off the nasal passageway. The[w] is voiced.

The French glide [ɥ]

This is a shortened form of the mixed vowel [y] and is sometimes called a semi-vowel. It is produced in the same way as [y] but moves quickly from one position to another. Shape the lips for [u] and pronounce [i] with the high point of the tongue forward in the mouth, close to the teeth ridge. The tip of the tongue touches the back of the bottom front teeth. The sides of the tongue laterally touch the inside of the upper molars.

The affricate (combination consonants) [tʃ], [dʒ] *and* [dz]

[tʃ]

This sound occurs in Italian, but not in French. In German it occurs rarely and is spelled tsch. The tongue blade touches the teeth ridge and the side of the tongue touch the upper side teeth to form a stop-plosive sound. The tongue tip then moves to a fricative position. The soft palate is raised, closing off the nasal passageway.

[dʒ]

Is produced the same way as above and is voiced. This sound does not exist in French and German. The sound occurs in Italian in words like *giusto* and *gemo*.

[dz]

The tongue tip is lifted and pressed against the back of the front teeth. Air shoots out over the tongue and between the front teeth. The soft palate is raised, closing off the nasal passageway. It occurs in Italian words spelled with z but does not exist in French or German.

The French and Italian [ɲ]

With slightly parted lips, put the tip of the tongue behind the bottom front teeth and lift the bald of the tongue to touch the front of the hard palate. Add voice for production of the nasal, palatal consonant sound *enya*. This sound does not exist in English or German.

The Italian [ʎ]

With slightly parted lips, put the tip of the tongue behind the bottom front teeth, arch the front of the tongue, lifting it to touch the front of the hard palate. Add voice and let the air exit laterally over the sides of the tongue. This sound does not exist in English, French or German.

CHAPTER 6

TRAINING AND RE-TRAINING OF MUSCLES IN RELATION TO TONGUE TENSION

The singer with tongue tension needs to identify vowels and consonants which could be contributing to the problem. Once the suspected contributors to tongue tension are found, then customized exercises can be created to relearn the execution of sounds and coordination of those particular articulations. The end result should be an execution of articulations by the tongue in an efficient and comfortable manner, not hyper produced.

Yawn-Sigh Technique[67]

According to William Vennard, the yawn-sigh technique is one of the most effective exercises to arrive at a balanced phonation for singing and to ease laryngeal tension. With the yawn-sigh technique the larynx drops to a low position, the pharynx is expanded, vocal folds have a slight opening and the tongue is more forward.

Many speech therapists use the following therapy technique for minimizing the tension effect of vocal hyperfunction.

1. The general physiology of the yawn is a prolonged inspiration with maximum widening of the supraglottal airways-wide stretching opening of the mouth.
2. After the yawn, repeat the yawn again and then exhale gently with a light phonation.
3. Once the yawn-phonation is easily achieved, say words beginning with [h]or open-mouth vowels, one word per yawn in the beginning, eventually four or five words on one exhalation.
4. The sigh phase is the prolonged, easy, open-mouthed exhalation after the yawn. Practice that after a quick, normal, open-mouthed inhalation .
5. When a relaxed sigh is produced, say [hah] after beginning the sigh. Follow this with a series of words beginning with the glottal [h]. Additional words for practice

[67] W. Vennard. *Singing-The Mechanism and the Technic.* New York: Carl Fischer, Inc. (1967); D.R. Boone, S.C McFarlane. *The Voice and Voice Therapy*. 5th Ed. Englewood Cliffs, NJ: Prentice Hall (1994), 221.

after the sigh should begin with central and back vowels. Blend the sigh with easy phonation.

6. Back vowels that require lip rounding (see vowels) are less tense then frontal vowels and therefore are more conducive to relaxing tension. Combining these vowels with the beginning of the yawn is a most effective means of reducing laryngeal tension[68]

7. Once the yawn-sigh approach is developed, pay attention to the relaxed oral feeling. Imagery will help to maintain relaxed phonation.

Muscoskeletal Tension Massage[69]

This massage is used if the yawn-sigh approach in itself is not enough. The massage demands an **extensive** knowledge of physiology of the neck and vocal tract so that the delicate tissue of the laryngeal voice box is not injured. It is strongly recommended that this takes place with a speech- language specialist.

When the larynx is too high and excessive laryngeal-neck muscle tension is obvious, Aronson recommends this procedure for reducing "muscoskeletal tension associated with hyperfunction."

1. Encircle the hyoid bone with the thumb and middle finger. Work back posteriorly until the major horns are felt.

2. Apply light pressure with the fingers in a circular motion over the tips of the hyoid bone.

3. Repeat this procedure with the fingers from the thyroid notch, working posteriorly.

4. Find the posterior borders of the thyroid cartilage (medial to the sternocleidomastoid muscles) and repeat the procedures.

5. With the fingers over the superior borders of the thyroid cartilage, begin to work the larynx gently downward and laterally at times.

6. Prolong vowels during these procedures, noting changes in quality and pitch . Clearer voice quality and lower pitch indicate relief of tension. Because of possible fatigue, rest periods should be provided.

7. Improvement in voice is immediately reinforced. Practice should be given in producing voice in vowels, words, phrases, and sentences.

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[68] J.C.McKinney. *The Diagnosis and Correction of Vocal Faults.* Nashville TN: Broadman Press (1982)

[69] A.E. Aronson. *Clinical Voice Disorders: An Interdisciplinary Approach* 3rd ed. New York: Thieme-Stratton. (1990)

8. Singer and therapist should discuss how voice related tension has been reduced. Repeat the procedures. Let the singer carefully maneuver their own larynx to a lower position.

According to research by Roy and Leeper[70], there will be short-term benefits from using laryngeal massage. Boone and McFarlane describes the results as "sudden effectiveness in reducing muscular tension and producing a more relaxed, lower pitched, resonant voice."

Tongue Protrusion

This approach can be very helpful for people with tongue tension causing "tightness" in their voice. The voice is often produced with the tongue held in a posterior position, with the pharyngeal constrictor muscles contracted, therefore making the pharynx smaller. When the tongue is protruded, its root is out of the pharynx and it opens the laryngeal aditus. This works to offset the squeezing of the pharynx. It is very important not to let the tongue protrude to far to cause other excessive muscular tension.

Boone and McFarlane use the following approach to relieve tongue tension and "tight" voice[71]:

1. Tongue should extended comfortably , the jaw "drop open" and a sustained high-pitched [i] voiced.

2. The individual should go up and down in pitch while sustaining the [i] vowel, with the mouth open and the tongue out. Listen for improved vocal quality. When this is achieved, sustained the tone.

3. On the sustained pitch achieved in the earlier exercise chant [mimimi] with the tongue still out of the mouth. Then slowly "slip" the tongue back into the mouth while continuing to produce the [mimimi].

[70] N.Roy, & H.A. Leeper. "Effects of the Manual Laryngeal Muscoskeletal Tension Reduction technique as a Treatment for Functional Voice Disorders: Perceptual and Acoustic Measures." *Journal of Voice* 7, (1993), 242-249.

[71] D.R. Boone , S.C McFarlane. *The Voice and Voice Therapy*. 5th Ed. Englewood Cliffs, NJ: Prentice Hall (1994), 216.

4. At this point, the pitch is usually still high. From this pitch sustain an **[i]** while lowering it by three steps from the original pitch. This often produce a good quality on the first step or the first two steps, but a return to the poor voice may occur at the third step. Repeat the procedure, but only go down two steps. Sustain the second step. Repeat until the tone is established. You may need to return to the original open mouth and tongue protrusion if the target tone is lost.

5. When the new tone is established, gradually add words to the sustained **[i]**. Examples of user friendly words: *be, pea,me,see,the peach* and *easy does it*.

Chewing

Habitual holding patterns, such as tongue tension, can benefit from the free-moving tongue used in chewing. According to Brodnitz and Froeschels[72] the oral structures (facial muscles, mandible and tongue), when involved in the automatic function of chewing, appears to relax the overall vocal tract and the phonatory functions of the larynx and pharynx. Empirical evidence support chewing exercises for singers who could benefit from associated relaxation of the throat and neck musculature. The primitive chewing with the tongue moving freely inside the oral cavity is most helpful. Many therapists and voice teachers have modified Froeschels' methods for their own use and some professional singers use small quantities of food to chew on between acts for relaxation of the vocal mechanism.[73]

Relaxation

The emotional state of a person also has an influence on the state of tension in the body including the tongue. A person who is stressed and tense will invariable put the excess tension into their voice.

The vertical positioning of the larynx, the relaxation of the vocal folds in vocal production and the posturing and relaxation of the pharynx and tongue are all influenced by, and

[72] F.S.Brodnitz. *Vocal rehabilitation.* Rochester MN:Whiting Press. (1961) E. Froeschels. "Chewing Method as Therapy." *Archives of Otolaryngology* 56 (1952), 427.

[73] R.Miller. *The Structure of Singing*. New York: Schirmer Books , (1996), 234.

responsive to our state of mind. When too much energy and effort is spent on voice production, and the vocal problem is associated with stress, symptomatic relaxation methods can be helpful. To eliminate unproductive stress one must become aware of the interplay that occurs within the body, and how tension can be released with relatively small changes of posture and mindset.

Differential relaxation is a good start. In this therapy the subject concentrates on a particular site of the body, deliberately tensing and relaxing those muscles (a contract-relax response). A recommended place to start is usually at the toes and then continuing up the limbs (from toe to foot, to leg) paying special attention to the head/neck/laryngeal area. Facial muscles should not be excluded. Relaxation of chin, lips, cheeks, temples, eyebrows, forehead and scalp can all greatly improve vocal quality.

Susanne Strömquist, ACSA certified personal trainer, suggests half-head rotations - from shoulder to shoulder. The head is dropped forward with a heavy feeling then slowly rolled over to one shoulder, extending the opposite neck muscles. Roll over to the other side and then back to the original position. Most people will find this relaxing and it can be a useful tool when trying to relax the vocal tract.

Imagery can also be very helpful. In this therapy the subject should to try to remember the ultimate experience of relaxation such as; lying in front of the fireplace, lying in a hammock,floating in a pool or what ever else triggers a relaxed sensation and then re-create that feeling when needed.

Most literature in this area will have sections pertaining to the tensing and relaxation of muscles of the neck, shoulders and arms, face and throat but one can also find good ideas in "self-help" books and by giving the whole body a complete work-out. Regular exercise programs have showed reduced overall tension and improved respiratory support, therefore giving the possibility of vocal improvements. Techniques used by speech-languages pathologists are mentioned below.

Exercises for Flexibility and Precision of the Tongue[74]

1. Push the tip of the tongue against the lower teeth. Push hard, harder. Relax the tongue suddenly. Push again, push very hard, then relax quickly. Do this several times.

2. Push the tip of your tongue against the upper teeth. Push hard, then relax, allowing the tongue to fall to the floor of the mouth. Repeat several times.

3. Push the tongue against the upper front teeth, let it fall to the floor of the mouth, push the tip against the lower teeth, relax. Repeat several times.

4. Press the tongue, alternating to upper and lower teeth on the right side several times. Repeat the process on the left side. Relax. Yawn to stretch mouth.

5. Press the tongue, alternating upper front with lower front teeth. Increase the speed of the alternation. Continue with alternations of both sides and upper front and lower front.

6. Raise the tongue tip, placing it against the upper front teeth. Quickly press it against the teeth in hard, short staccato attacks. Listen while doing this. A clicking sound should be heard and the mouth should fill with saliva when doing this correctly. Do not overdo this "trip-hammer" exercise.

7. Hum very easily on a comfortable pitch for eight to twelve slow beats. Then roll the tongue around in the mouth in a circular motion, keeping the lips closed.

Exercises for Relaxing the Tongue

Timerding writes,"While exercising with conscious awareness of the movements of the tongue for articulation and singing it is impossible to produce the best quality of singing. It is only after difficulties with the tongue have been corrected and the student is no longer in need of very cognitively driven exercises that he or she is able to sing with freedom and grace."[75]

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[74] J.A Fracht and E. Robinsson. *You Too Can Sing*. New York: Tudor Publishing Company, (1960), 101-102.
[75] E.F. Timerding. "Taming of the Unruly Tongue: Problems and Remedies Associated with the Singer's Tongue." *Journal of Singing* 54:2(1997), 13-20.

1. Place the tip of the tongue on the lower front teeth, or in the pocket between the lower teeth and chin and lip. The body of the tongue should then be pushed forward out of the mouth.

2. Sing through the repertoire with the tip of the tongue placed on the lower teeth[76].

3. Precede the vowels in vocalizations with the unvoiced "th"[77].

4. Stretch the tongue out and try to touch your chin. Repeat several times.

5. Stretch your tongue out and try to touch your nose with the tip of the tongue.

6. With the mouth closed (lips together) place the tongue between the upper and lower teeth on both sides and in front. Make the tongue wide and flat. Hold lightly in place with the teeth until the base of the tongue is relaxed.

7. Breath through the nose. This usually relaxes the tongue.

8. Pummel the area under the chin lightly with fingertips, fingernail side. Using fingertips lightly massage throat and neck with circular strokes. Standing tall relax arms at your side and look straight ahead. Slowly turn your head 90° to the right. Pause. Slowly turn head 180° to the left. Pause. Slowly turn head straight forward again.

Vocal Exercises for Relieving Tongue Tension

1. The rolling R

   Begin this exercise on a comfortable pitch in the lower part of the singers ambitus. With the tip of the tongue do a tongue trill on a scale from 5 to 1. Work the scale a ½ step higher until a full octave is covered. The tongue is relaxed and thick, except for the tip that is doing all the articulatory work.

2. TRI-TRA

   Start this exercise in the middle register (for sopranos on middle G). With the tip of the tongue behind the upper front teeth initiate the [t], then flip the tongue for [r], finally producing [i] and [a] with the body of the tongue behind the lower front teeth and the back arching or releasing depending on vowel.

3. Cho-co-la-te

   On a single pitch in comfortable register, slowly produce one syllable per beat. Let the tongue do all the articulatory work, the jaw stays in a release, unhinged position.

[76] W. Locke. "Rx for Relaxation." *Journal of Church Music* 28 (1986), 4-5.
[77] B. Doscher. *The Functional Unity of the Singing Voice.* Metuchen, NJ and London: The Scarecrow Press (1988), 97.

This exercise cover a multitude of tongue movements. Therefore it is important to take time to familiarize oneself with the intricate details of the tongues articulatory gestures.

4. This exercise could be helpful in releasing tongue tension at the root of the tongue. Begin the exercise on A below middle C and work up an arpeggio scale (1,3,5,8,10,8,5,3,1) The tongue starts on **[a]** alternating with **[ɪ]** with the tongue protruding out of the mouth on the next pitch, keep alternating covering the full scale. Raise the scale ½ step and repeat with **[a]**, **[ɪ]**,**[a]**,**[ɪ]** and so on. Repeat this exercise five times.

5. With release, unhinged jaw let the tip of the tongue quickly move through lalala's on a scale of 898,787,676,5,454,343,232,1. Raise the scale ½ step until one octave is covered.

CHAPTER 7

CONCLUSION

Any uncoordinated or hyperfunctional muscle activity anywhere in the body can have an impact on other muscles in the body. Tension or hyperfunction in the tongue not only by itself can hamper or impair beautiful singing but can impact other musculature involved in the singing process. Because the trained singer must keep in mind many different issues including posture, movement, vocal technique, languages, interpretation, acting and reacting, and ensemble with accompaniment, something as basic as the movements of the tongue for articulation must be properly trained to function efficiently without tension by habit.

During my years as private voice teacher and choral conductor I have often observed the unconscious pulling of the tongue, especially at higher pitches, and the contracting after swallowing. This leads to unnecessary tension, and a struggle by the singer to find the space and resonance in the vocal tract that are associated with the sensation of free beautiful singing.

In my opinion, tongue tension is one of the most undesirable tension problems a singer can have. The reason for this problem varies, but can include bad posture, inefficient use of the tongue for articulation, and uncoordinated or less then optimal breath support. As a compensation, the tongue tenses, and often the larynx is pulled upward or raised from its desired, low, position.

Since the tongue is not one but many muscles, it is important to find out where the tension is located and plan vocalization and articulation exercises accordingly. Tongue root tension, which often occur when a singer is tired, can be helped by massage. This massage is done from the outside, at the floor of the mouth, by pressing and releasing, like acupressure, or by simply "painting circles" with the index fingers. Tension in other parts of the tongue might benefit from in-out movements or tense-flex combinations so that the singer experiences the articulation gestures.

I consider the most important tongue movement to be the one that opens up space in the back of the oral cavity, expand the available space for acoustic amplification, so the airflow can vibrate freely. If a singer applies Richard Miller's principle of tongue placement[78], the singer will accomplish a position of the tongue that is out of the way of tonal resonance and remains soft and flexible. A combination of deep breath support (use of Rectus Abdominus and Transverse Obliques) and good head-neck alignment will also contribute to a soft and flexible tongue.

There is not one solution to excessive tongue tension, but if the singer and the teacher are aware of the problem and will make a plan of action for altering the articulation habits and possibly breath technique and posture, the excessive tension in the tongue can become obsolete. This will assist in the goal of accomplishing freely and efficiently produced beautiful singing which is central to successful singing.

[78] R.Miller. *The Structure of Singing.* New York: Schirmer Books, (1996), 69.

APPENDIX

WORD BANK

Abdomen	Region of the body between the thorax and pelvis
Abduct	To draw a structure away from midline
Adduct	To draw two structures closer together toward midline
Aditus	Entryway
Allophone	Any slight variation within that same sound.
Alveolar ridge	Rim of gum behind the upper front teeth
Ambitus	Range
Antagonist	A muscle that opposes the contraction of another muscle
Anterior	In front of
Apex	Tip, peak
Approximate	To bring closer together
Articulatory system	The system of structures involved in shaping the the oral cavity for production of the sounds of speech.
Aspirate	Release of air before phonation, the [h]
Atrophy	Muscular wasting
Auditory feedback	Monitoring singing or speech by ear
Breathy phonation	Vocal tone produced with too little vocal fold closure
Breathy tone	Tone with excessive air leakage, whisper
Cartilage	Connective tissue
Cartilaginous joints	Joint in which cartilage serves to connect two bones
Cartilaginous	Constructed of cartilage
Central nervous system	Brain and spinal cord components
Corpus	Body
Deglutition	Swallowing
Diaphragm	Dome-shaped muscle that separates the thoracic and abdominal cavities and assist in inspiration

Dorsal	Back of body
Dorsum	Back of a structure
Eustachian tube	Tube connecting the middle ear with the throat
Exhalation	Releasing air from the lungs
External	Toward the exterior of the body
Fibrous	Tissue composed of thread like structure
Flexion	The act of bending
Flow phonation	Vocal sound produced with optimum balance between vocal fold pressure and subglottic air pressure
Formant	Frequency of the vibration of vocal tract resonators
Frenum	A small band of tissue connection two structures
Frequency	Number of cycles of vibration per second
Frontal	Pertaining to the front, anterior
Fundamental frequency	The lowest frequency of vibration of the vocal folds
Glottis	The space between the true vocal folds
Hard palate	The bony portion of the roof of the mouth
Hertz	Cycles per second
Hyperfunction	Too much of something
Hypofunction	Too little of something
Impedance	Resistance to flow of energy
Inferior	The lower point
Innervation	Stimulation by means of a nerve
Inspiration	Inhalation, intake of air to the respiratory system
Intercostal	Between the ribs
Ipsilateral	Same side

Jitter	Irregular variations of fundamental frequencies
Laminae	A flat membrane
Laryngologist	Specialist in the study of vocal pathology
Lateral	Toward the side
Ligaments	Fibrous connective tissue connecting bone and cartilages
Lingual	Referring to the tongue
Low register	Vocal folds are thick, low laryngeal position also called chest register
Mandible	Jaw bone
Mastication	Chewing
Medial	Toward the midline of the body of a structure
Medial compression	The degree of force that may be applied by the vocal folds at their point of contact
Median	Middle
Middle register	A mixture of low and high registers
Mucous	Tissue which secrets mucus
Muscle	An collection of muscle fibers with functional unity
Oblique	Diagonal
Oral cavity	The region extending from the opening of the mouth in the front and bounded laterally by the dental arches and posteriorly by the fauces
Origin	Point of attachment of a muscle with relatively little movement
Ossified	The process of tissue turning into bone
Palatine tonsils	Lymphoid tissue between the fauces
Pars	Part
Period	The time required to complete one cycle of vibration or movement
Phonation	The voiced tone produced by the vibrating vocal folds

Phonatory system	The system including the laryngeal structures through which phonation is achieved
Physiology	The study of the functions of the body and its components
Posterior	Toward the rear
Pressure	The derived measure representing a force expanded over an area
Process	A prominence of an anatomical structure
Protrusion	Sticking out (tongue)
Proximal	Closer to trunk or thorax
Respiration	The process of exchange of gas between an organism and its environment
Register	Series of consecutive tones of like quality and coordination
Resonance	Additions of supplemental vibrations to enrich or intensify sound
Resonance frequencies	Frequency of stimulation to which a resonant system responds most vigorously
Resonators	Bony portions of the head and neck area which add vibration to the fundamental sound produced by the larynx
Respiration	Process of inhaling and exhaling breath to sustain life
Respiratory system	The physical system involved in respiration, including the lungs, bronchial passageway, trachea, larynx, pharynx, oral, and nasal cavities
Resting lung volume	The volume of air remaining within the lungs after quiet exhalation
Retracted tongue	Tongue position pulled back in the throat
Shimmer	Instability in amplitude from cycle to cycle
Sinus	A cavity or passageway
SNR	Signal to noise ratio
Soft palate/velum	The soft structure separating the oropharynx and nasopharynx

Speech pathologist	A professional that holds at least a Master's degree in Speech Pathology and Audiology trained in treatment of voice disorders
Stridency	A harsh, grating voice quality
Subglottal pressure	Air pressure generated by the respiratory system beneath the level of the vocal folds
Superficial	Near to surface
Superior	The upper point
Symphysis	A union of two structures that were separated in earlier development, resulting in immobile articulation
Synovial joint	Joints which are contained in a sac and lubricated by synovial fluid
Tendon	Connective tissue attaching muscle to bone or cartilage
Thorax	Part of the body between the neck and the abdomen, enclosed by the ribs, sternum and spine
Timbre	Quality or color of sound
Torso	The trunk of the body
Trachea	Windpipe
Transverse	At right angles to the long axis
Tremor	Minute, involuntary repetitive movements
Unilateral	One side
Uvula	Small fleshy protuberance from the posterior of the soft palate
Upper register	Laryngeal adjustment of vocal folds making them thin and stiffened, for higher pitches. Also called head register.
Velum	See soft palate
Vocal intensity	Sound pressure level associated of a given speech product
Voice	Sound produced by vibration of the vocal folds and supplemented by resonance of the vocal tract.

Voice teacher	A professional trained to training singers in vocal technique, languages, and interpretation
Voice therapist	A professional trained to diagnose and treat voice disorders
Western tradition	Classical music style born from the church mode system

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